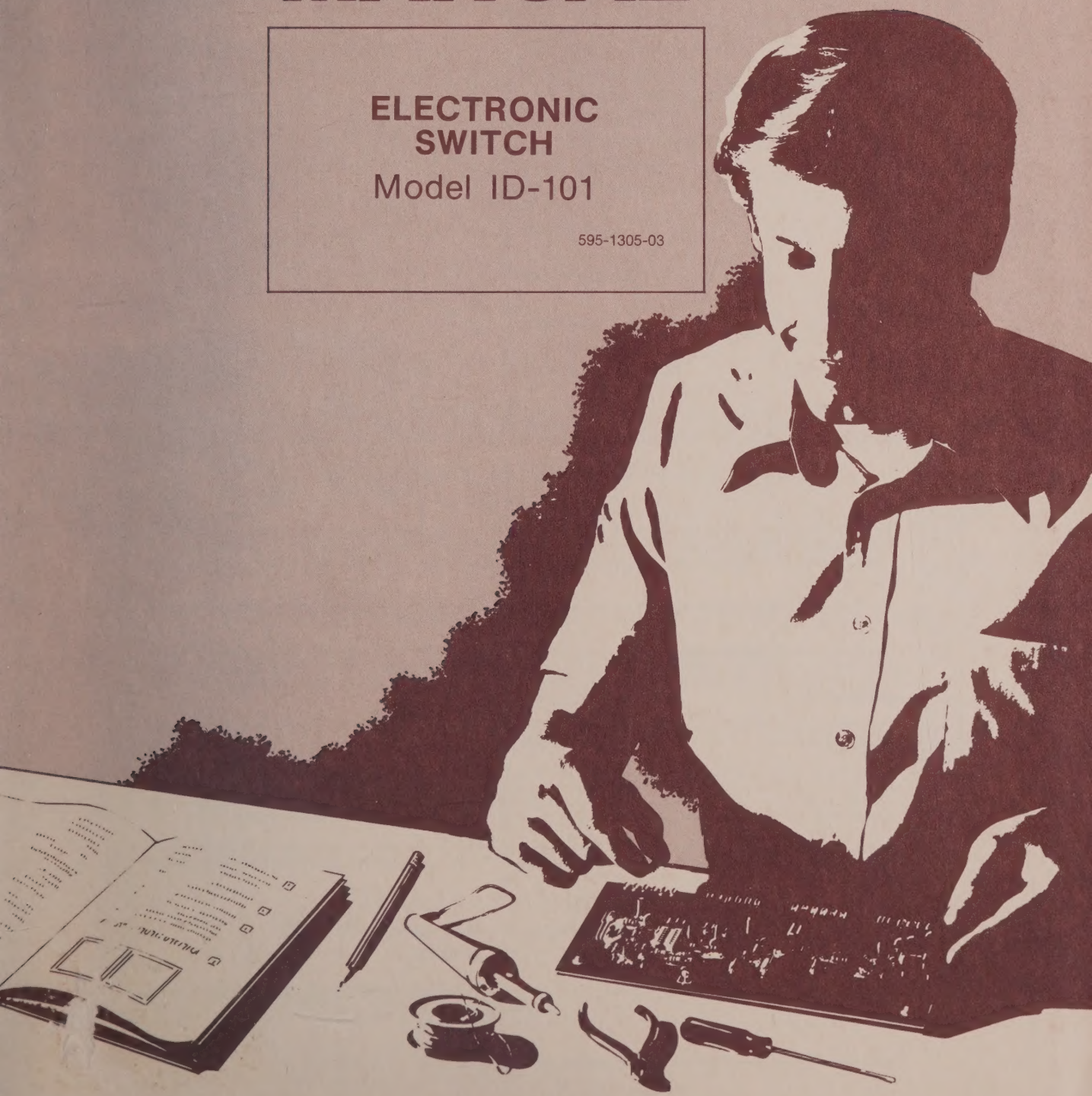
HEATHKIT® MANUAL

ELECTRONIC SWITCH

Model ID-101

595-1305-03



HEATH COMPANY • BENTON HARBOR, MICHIGAN

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During your first ninety (90) days of ownership, Heath Company will replace or repair free of charge — as soon as practical — any parts which are defective, either in materials or workmanship. You can obtain parts directly from Heath Company by writing us or telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that, during the first ninety (90) days of ownership, our products, when correctly assembled, calibrated, adjusted, and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period, through no fault of yours, we will service it free upon delivery at your expense to the Heath factory, Benton Harbor, Michigan, or to any Heathkit Electronic Center (units of Schlumberger Products Corporation), or through any of our authorized overseas distributors.

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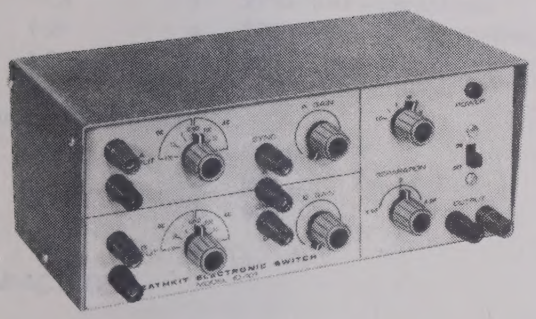
And if you are dissatisfied with our service — warranty or otherwise — or our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan, 49022. He'll make certain your problems receive immediate, personal attention.

HEATH COMPANY
BENTON HARBOR, MI. 49022

Prices and specifications subject to change without notice.

Assembly and Operation of the HEATHKIT® ELECTRONIC SWITCH

MODEL ID-101



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INTRODUCTION

The Heathkit Model ID-101 Electronic Switch provides a simultaneous visual display of two input signals on a single-beam oscilloscope. The Electronic Switch alternates from one input signal to the other at a selected rate. The front panel Mode switch selects one of four frequencies to provide the most favorable presentation on the oscilloscope, or a single "A" or "B" input trace.

A Sync output on each channel permits the oscilloscope sweep (external sync input) to be locked to either input signal. Conventional binding posts are used for easy, rapid connections. However, the Electronic Switch may be left connected to the oscilloscope at all times.

These features of the all-solid-state Model ID-101 Electronic Switch make it ideal for general purpose use. The compact size and attractive style will be highly compatible with your test equipment.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

Unpack all the packages and check each part against the following list. Place diodes and transistors back in their individual packages until they are called for in a step. The key numbers correspond to the numbers in the Parts Pictorial (fold-out from Page 5).

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For pricing information, refer to the separate "Heath Parts Price List."

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS			
A1	1-3	2	100 Ω (brown-black-brown)
A1	1-6	3	470 Ω (yellow-violet-brown)
A1	1-8	4	820 Ω (gray-red-brown)
A1	1-9	4	1000 Ω (brown-black-red)
A1	1-11	2	1500 Ω (brown-green-red)
A1	1-44	2	2200 Ω (red-red-red)
A1	1-16	9	4700 Ω (yellow-violet-red)
A1	1-20	3	10 kΩ (brown-black-orange)
A1	1-23	1	27 kΩ (red-violet-orange)
A1	1-26	4	100 kΩ (brown-black-yellow)
A1	1-68	1	820 kΩ (gray-red-yellow)
Precision Resistors			
A2	2-50	2	10 kΩ
A2	2-41	2	90 kΩ
A2	2-51	2	900 kΩ
CAPACITORS			
Disc			
A3	21-32	4	47 pF
A3	21-9	1	100 pF
A3	21-23	2	420 pF
A3	21-140	1	.001 μF
A3	21-46	1	.005 μF (.005 k)
A3	21-16	5	.01 μF
A3	21-48	1	.05 μF
Other			
A4	20-167	2	620 pF mica
A5	23-10	2	.05 μF paper
A6	25-273	2	250 μF electrolytic
A7	27-36	2	.01 μF Mylar*
A8	27-47	2	.1 μF Mylar
A9	31-18	2	Dual trimmer assembly

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
CONTROLS AND SWITCHES			
A10	10-382	2	2000 Ω control
A10	10-383	2	10 kΩ control
A11	10-269	2	2000 Ω control
A12	12-114	1	5000 Ω dual control
A13	60-1	1	Slide switch
A14	63-444	1	7-lug rotary switch
	63-605	2	6-lug rotary switch
DIODES-LAMP-TRANSISTORS			
B1	56-45	1	VR20 zener diode
B1	56-56	2	1N4149 silicon diode
B1	56-57	2	1N716A zener diode
B1	57-65	4	1N4002 silicon diode
B2	412-15	1	Neon lamp
B3	417-118	20	2N3393 transistor
B3	417-169	2	MPF105 transistor
B3	417-201	3	X29A829 transistor
B4	417-852	1	TIP31B transistor
METAL PARTS			
B5	90-446-1	1	Cabinet top
B6	200-611-1	1	Chassis
B7	203-793-1	1	Front panel
B8	206-528	1	Vertical shield
B9	206-529	1	Horizontal shield
WIRE-SLEEVING-CABLE			
	89-23	1	Line cord
	343-15	1	Shielded cable
	344-31	1	Brown wire
	344-59	1	White wire
	346-1	1	Sleeving

*DuPont Registered Trademark

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
HARDWARE			
C1	250-56	6	6-32 x 1/4" screw
C2	250-170	6	#6 x 1/4" sheet metal screw
C3	250-89	17	6-32 x 3/8" screw
C4	252-3	27	6-32 nut
C5	252-7	6	Control nut
C6	252-73	1	Push-on nut
C7	254-1	30	#6 lockwasher
C8	254-27	4	#6 external lockwasher
C9	254-4	3	Control lockwasher
C10	253-10	6	Control flat washer
C11	255-23	4	Spacer
C12	259-1	9	#6 shakeproof solder lug
C13	259-10	1	Control solder lug
MISCELLANEOUS			
D1	54-273	1	Transformer
D2	73-52	2	Grommet
D3	427-3	9	Binding post base
D4	75-17	14	Binding post insulator
D5	100-16-2	4	Black binding post cap

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
Miscellaneous (cont'd.)			
D5	100-16-18	3	Red binding post cap
D5	100-534	2	White binding post cap
D6	75-52	1	Switch insulator
D7	75-71	1	Strain relief
	85-501-1	1	Circuit board
D8	261-29	4	Plastic foot
D9	413-10	1	Lens
D10	421-26	1	1/8-ampere 3AG, slow-blow fuse
D11	422-1	1	Fuseholder
D12	431-42	1	Terminal strip
D13	431-82	1	Terminal collar
D14	455-50	6	Knob bushing
D15	462-248	6	Knob
	490-5	1	Nut starter
	390-1255	1	Fuse label
	391-34	1	Blue and white label
	597-260	1	Parts Order Form
	597-308	1	Kit Builders Guide
		1	Manual (See front cover for part number.)
			Solder

STEP-BY-STEP ASSEMBLY

Before starting to assemble this Kit, read the "Kit Builders Guide" for complete information on wiring, soldering, and step-by-step assembly procedures.

Position all parts as shown in the Pictorials. Follow the instructions carefully, and read the entire step before performing the operation.

All resistors will be called out by the resistance value (in Ω or kΩ); the color code will also be given for color-coded resistors. Capacitors will be called out by the capacitance value and type.

CIRCUIT BOARD ASSEMBLY

Only part of the circuit board is shown in the following Pictorials. An identification drawing at the top of each of these Pictorials shows the area of the circuit board to be assembled.

START

IDENTIFICATION DRAWING

PART NUMBER

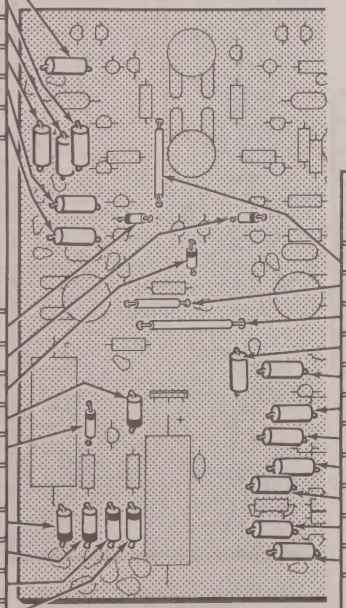
FOR GOOD SOLDER CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN. WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

- ( ) 100 kΩ (brown-black-yellow).
- ( ) 820 Ω (gray-red-brown).
- ( ) 820 Ω (gray-red-brown).
- ( ) 100 Ω (brown-black-brown).
- ( ) 4700 Ω (yellow-violet-red).
- ( ) 4700 Ω (yellow-violet-red).

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. THE CATHODE END OF THE DIODE IS MARKED WITH A BAND OR BANDS. ALWAYS POSITION THIS END AS SHOWN IN THE PICTORIAL.

BAND OR BANDS

- ( ) Silicon diode 1N4149 (#56-56).
- ( ) Silicon diode 1N4149 (#56-56).
- ( ) Zener diode 1N716A (#56-57).
- ( ) Zener diode VR20 (#56-45).
- ( ) Zener diode 1N716A (#56-57).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.
- ( ) Silicon diode 1N4002 (#57-65).
- ( ) Silicon diode 1N4002 (#57-65).
- ( ) Silicon diode 1N4002 (#57-65).
- ( ) Silicon diode 1N4002 (#57-65).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

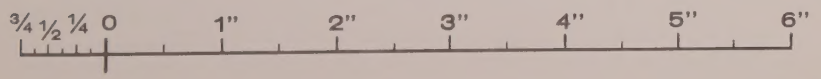


CONTINUE

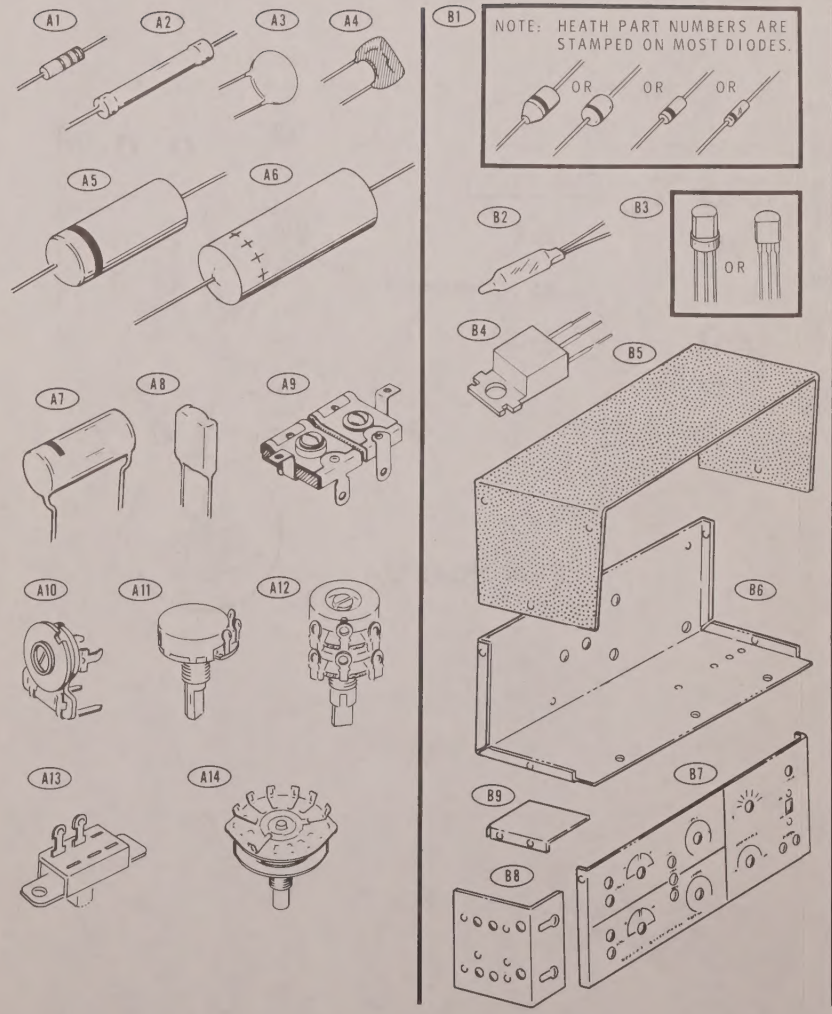
NOTE: When a jumper wire is called for, use white solid wire. Cut the wire to the specified length. Then remove 1/4" of insulation from each end.

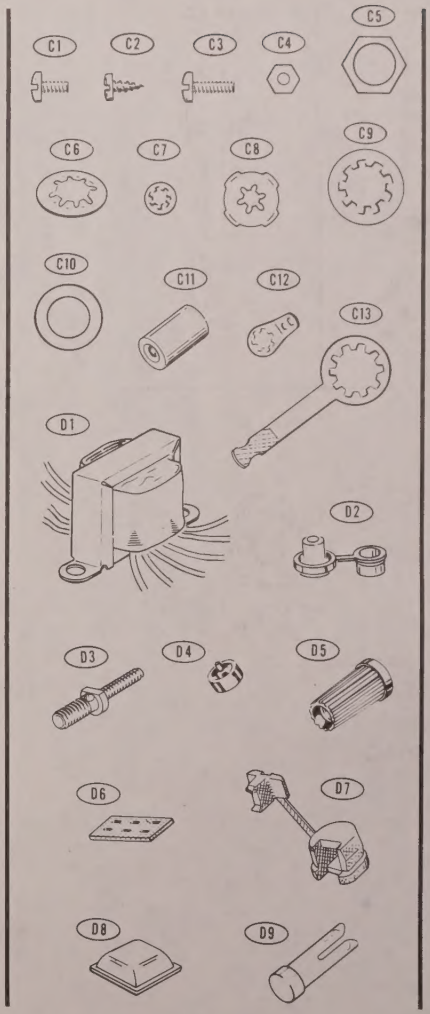
- ( ) 1-3/8" jumper wire.
- ( ) 1" jumper wire.
- ( ) 1-1/2" jumper wire.
- ( ) 1000 Ω (brown-black-red).
- ( ) 10 kΩ (brown-black-orange).
- ( ) 100 kΩ (brown-black-yellow).
- ( ) 10 kΩ (brown-black-orange).
- ( ) 100 kΩ (brown-black-yellow).
- ( ) 4700 Ω (yellow-violet-red).
- ( ) 4700 Ω (yellow-violet-red).
- ( ) 820 kΩ (gray-red-yellow).
- ( ) Solder the leads to the foil and cut off the excess lead lengths.

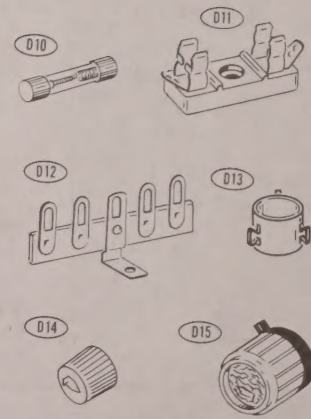
PICTORIAL 1-1

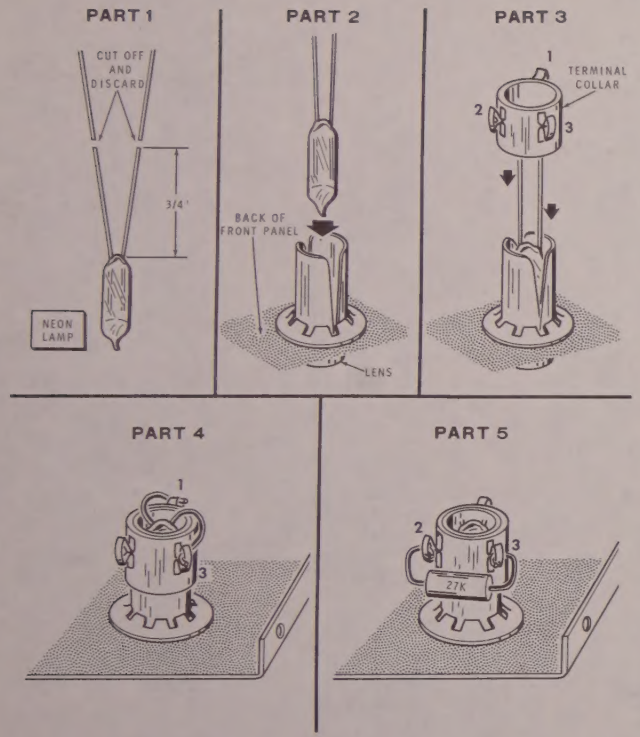


PARTS PICTORIAL

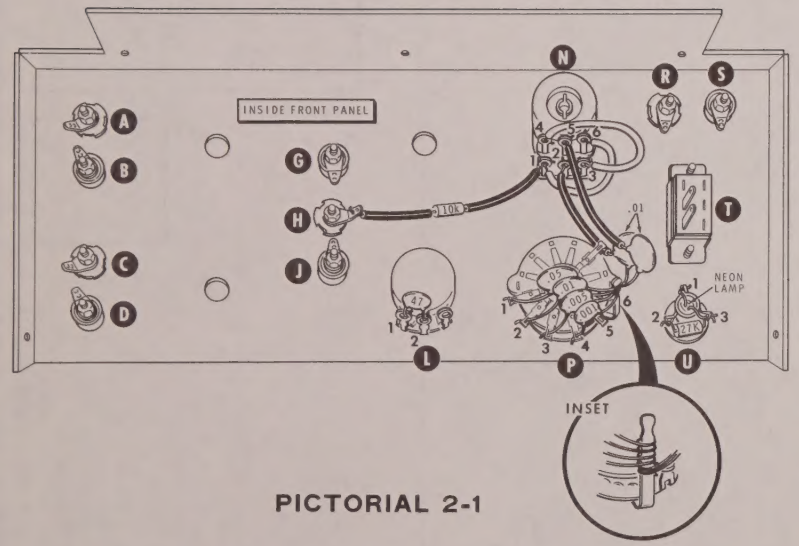




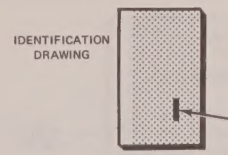




Detail 2-1G



PICTORIAL 2-1



START

( ) 470 Ω (yellow-violet-brown).

( ) 470 Ω (yellow-violet-brown).

( ) 1500 Ω (brown-green-red).

( ) 1500 Ω (brown-green-red).

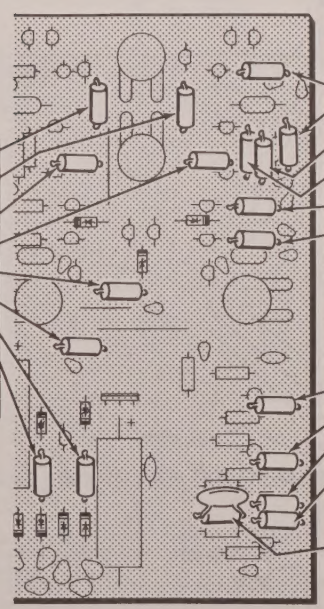
( ) 470 Ω (yellow-violet-brown).

( ) 2200 Ω (red-red-red).

( ) 1000 Ω (brown-black-red).

( ) 1000 Ω (brown-black-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

( ) 100 kΩ (brown-black-yellow).

( ) 100 Ω (brown-black-brown).

( ) 820 Ω (gray-red-brown).

( ) 820 Ω (gray-red-brown).

( ) 4700 Ω (yellow-violet-red).

( ) 4700 Ω (yellow-violet-red).

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN. WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) 4700 Ω (yellow-violet-red).

( ) 4700 Ω (yellow-violet-red).

( ) 2200 Ω (red-red-red).

( ) 1000 Ω (brown-black-red).

( ) Prepare a resistor-capacitor combination as shown below. Use a 4700 Ω (yellow-violet-red) resistor and a 100 pF disc capacitor.

SOLDER AND CUT OFF

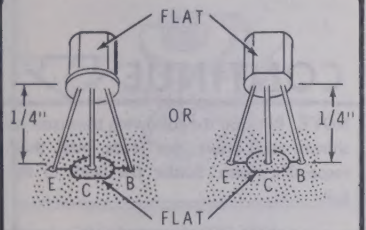
SOLDER AND CUT OFF

( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-2

START

( ) Locate sixteen 2N3393 (#417-118) transistors. NOTE: Install them as shown. Line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the leads into their correct holes indicated by E, C, and B. Solder each lead to the foil and cut off the excess lead lengths.



( ) 2N3393 transistor at Q104.

( ) 2N3393 transistor at Q106.

( ) 2N3393 transistor at Q108.

( ) 2N3393 transistor at Q112.

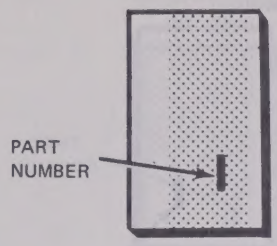
( ) 2N3393 transistor at Q114.

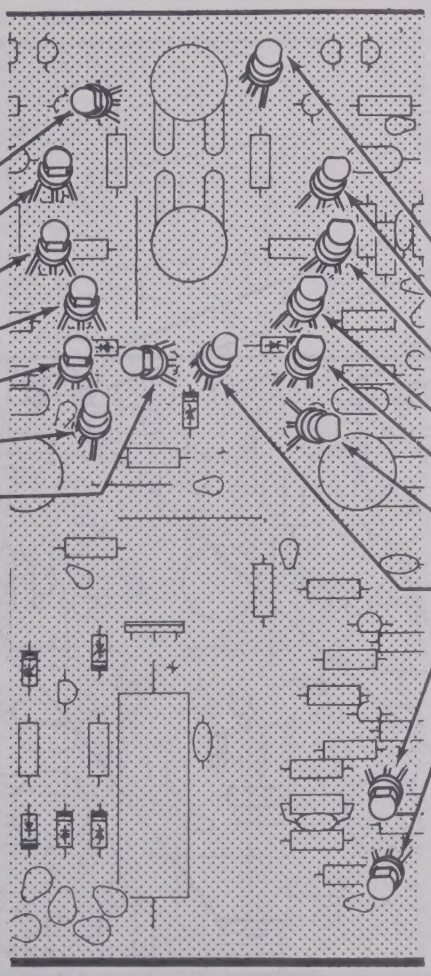
( ) 2N3393 transistor at Q110.

( ) 2N3393 transistor at Q302.

( ) Check to see that all the leads are soldered, and cut off the excess lead lengths.

IDENTIFICATION DRAWING





CONTINUE

( ) 2N3393 transistor at Q103.

( ) 2N3393 transistor at Q105.

( ) 2N3393 transistor at Q107.

( ) 2N3393 transistor at Q111.

( ) 2N3393 transistor at Q113.

( ) 2N3393 transistor at Q109.

( ) 2N3393 transistor at Q301.

( ) 2N3393 transistor at Q202.

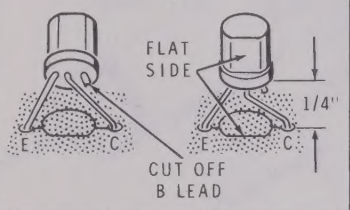
( ) 2N3393 transistor at Q201.

( ) Check to see that all the leads are soldered, and cut off the excess lead lengths.

PICTORIAL 1-3

START

( ) Locate four 2N3393 (#417-118) transistors. Cut off the B lead and install them as shown. Line up the flat of the transistor with the outline of the flat on the circuit board. Insert the leads into their correct holes indicated by E and C. Solder each lead to the foil and cut off the excess lead length.



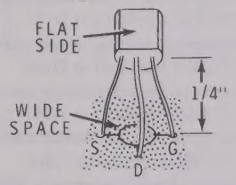
( ) 2N3393 transistor at D103.

( ) 2N3393 transistor at D101.

( ) 2N3393 transistor at D104.

( ) 2N3393 transistor at D102.

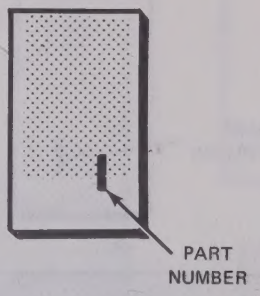
NOTE: Install the next two transistors in the following manner as shown. Solder the leads to the foil.

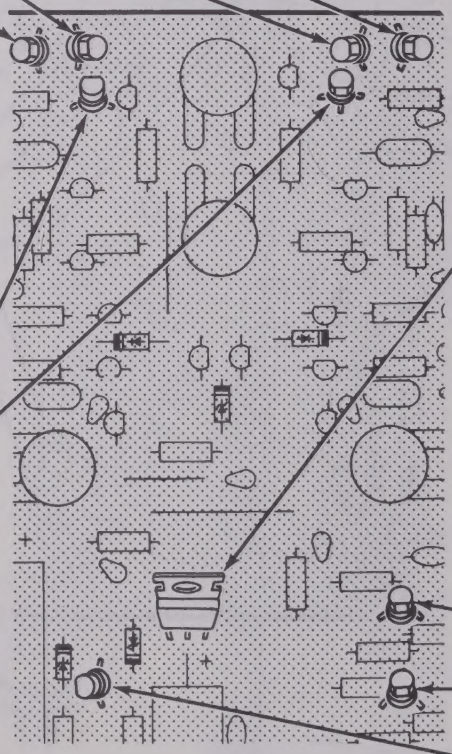


( ) MPF105 (#417-169) transistor at Q102.

( ) MPF105 (#417-169) transistor at Q101.

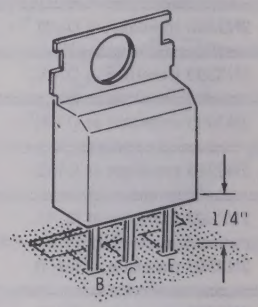
IDENTIFICATION DRAWING





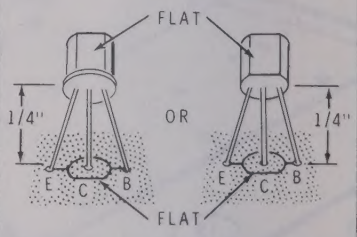
CONTINUE

NOTE: Position the following transistor as shown and insert the leads into their respective holes. Solder the leads to the foil.



( ) TIP31B (#417-852) transistor at Q401.

NOTE: Install the next three transistors as shown. Solder the leads to the foil.



( ) X29A829 (#417-201) transistor at Q204.

( ) X29A829 (#417-201) transistor at Q203.

( ) X29A829 (#417-201) transistor at Q402.

( ) Check to see that all the leads are soldered and cut off the excess lead lengths.

PICTORIAL 1-4

START

To install a control, insert the control lugs and then the mounting lugs through the circuit board. Seat each control firmly against the circuit board and solder the lugs to the foil.

( ) 10 kΩ control (#10-383).

( ) 10 kΩ control (#10-383).

( ) 2000 Ω control (#10-382).

( ) 2000 Ω control (#10-382).

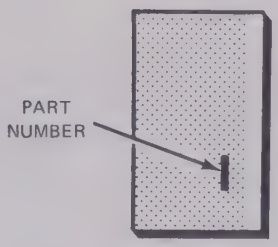
NOTE: When you install electrolytic capacitors, always match the positive (+) marked end of the capacitor with the positive (+) mark on the circuit board.

( ) 250 μF electrolytic.

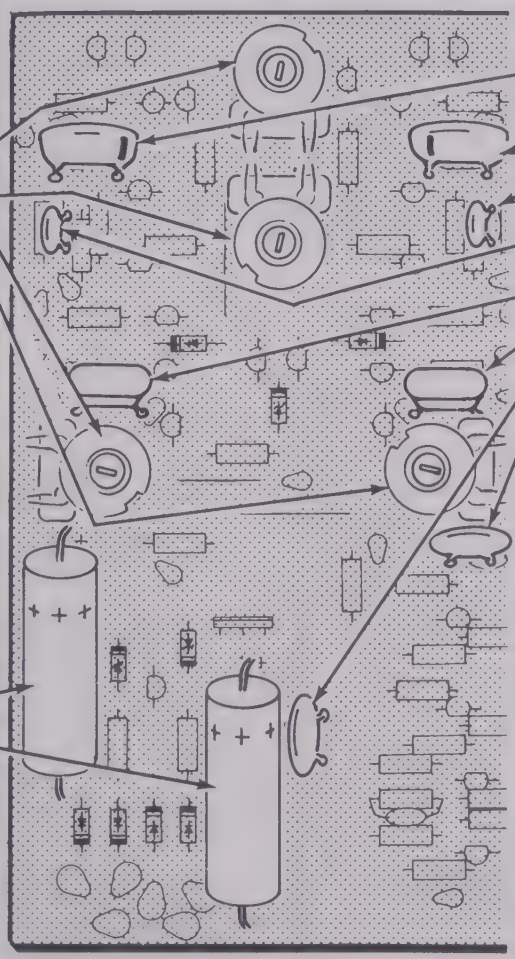
( ) 250 μF electrolytic.

( ) Solder the leads to the foil and cut off the excess lead lengths.

IDENTIFICATION DRAWING



SOLDERING IRON TIP



CONTINUE

( ) .01 μF Mylar. Disregard the position of the band.

( ) .01 μF Mylar. Disregard the position of the band.

( ) 420 pF disc.

( ) 420 pF disc.

( ) .1 μF Mylar.

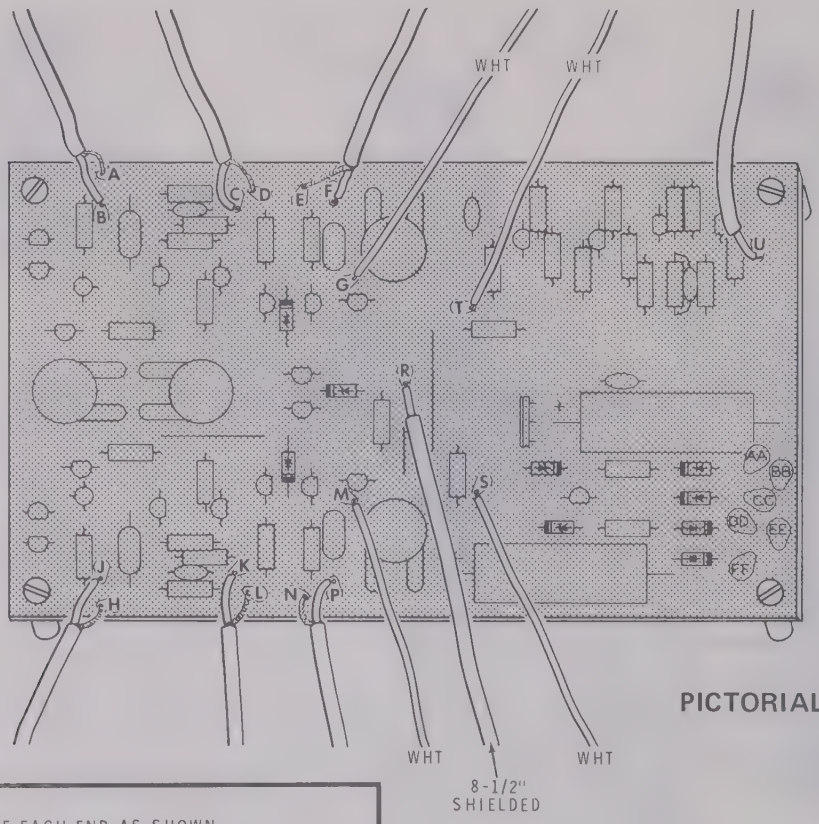
( ) .1 μF Mylar.

( ) .01 μF disc.

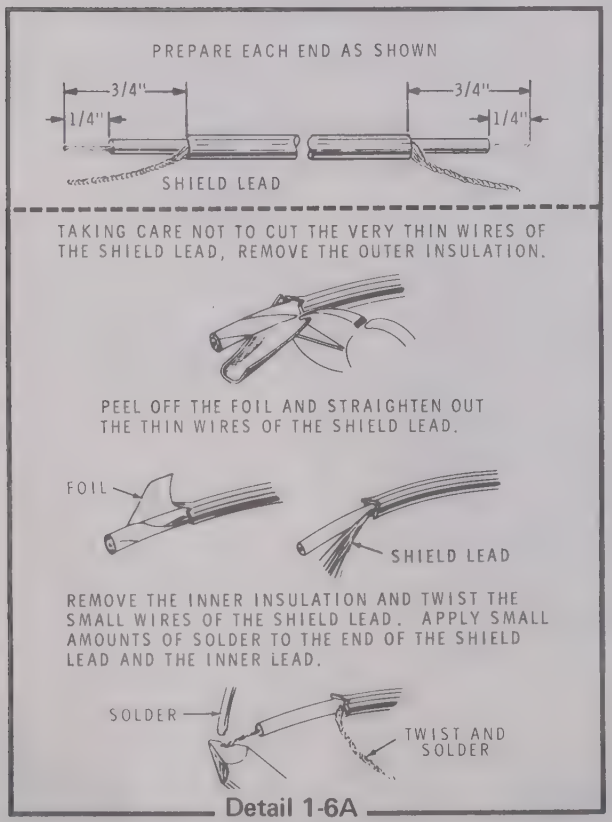
( ) .01 μF disc.

( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-5



PICTORIAL 1-6


PREPARE EACH END AS SHOWN
3/4"
1/4"
3/4"
1/4"
SHIELD LEAD
TAKING CARE NOT TO CUT THE VERY THIN WIRES OF THE SHIELD LEAD, REMOVE THE OUTER INSULATION.
PEEL OFF THE FOIL AND STRAIGHTEN OUT THE THIN WIRES OF THE SHIELD LEAD.
FOIL
SHIELD LEAD
REMOVE THE INNER INSULATION AND TWIST THE SMALL WIRES OF THE SHIELD LEAD. APPLY SMALL AMOUNTS OF SOLDER TO THE END OF THE SHIELD LEAD AND THE INNER LEAD.
SOLDER
TWIST AND SOLDER

Detail 1-6A

Refer to Pictorial 1-6 for the following steps.

( ) Refer to Detail 1-6A and prepare the following lengths of shielded cable:

QUANTITY	LENGTH
7	5"
1	8-1/2"

NOTE: In the following steps, solder each lead of a cable as it is installed; the leads on the free end of the cable will be connected later.

( ) Cut the shield lead off one end of an 8-1/2" shielded cable and connect the center lead of this end to hole R on the circuit board.

( ) Cut the shield lead off one end of a 5" shielded cable and connect the center lead of this end to hole U on the circuit board.

NOTE: In the following steps, connect one end of each of the remaining shielded cables to the indicated holes on the circuit board. Solder each lead as it is installed. The free end of each cable will be connected later.

( ) Center lead to hole B; shield lead to hole A.

( ) Center lead to hole C; shield lead to hole D.

( ) Center lead to hole F; shield lead to hole E.

( ) Center lead to hole J; shield lead to hole H.

( ) Center lead to hole K; shield lead to hole L.

( ) Center lead to hole P; shield lead to hole N.

NOTE: To prepare a length of wire, cut the wire to the specified length and remove 1/4" insulation from each end.

( ) Prepare four 5" lengths of white wire.

( ) Connect one end of each of the white wires to the following holes on the circuit board. Solder each wire as it is connected. The other end will be connected later.

( ) White wire to hole G.

( ) White wire to hole M.

( ) White wire to hole S.

( ) White wire to hole T.

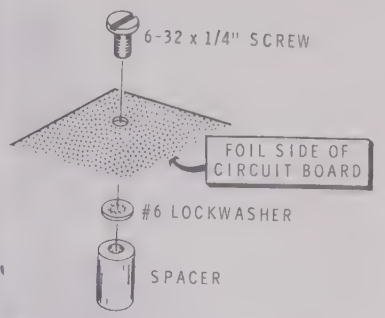
( ) Trim off the excess lead lengths from the foil side of the circuit board.

( ) Prepare a 12" length of white wire.

( ) Refer to Detail 1-6B and solder one end of the 12" wire to the foil pad of the collector of Q203 (on the foil side of the circuit board). Do not bridge solder between the foils. The other end of the wire will be used later in the adjustments; coil it out of the way until it is called for.

NOTE: When hardware is called for in a step, only the screw size will be given. For instance: if 6-32 x 1/4" hardware is called for, it means that a 6-32 x 1/4" screw, one or more #6 lockwashers and a 6-32 nut should be used. Or if control hardware is called for, use the number of control flat washers, control lockwashers, and control nuts shown. The Pictorial or Detail will show the proper number and location of parts used.

Detail 1-6B



Detail 1-6C

( ) Refer to Detail 1-6C and install spacers, on the foil side, at each corner of the circuit board. Use 6-32 x 1/4" hardware.

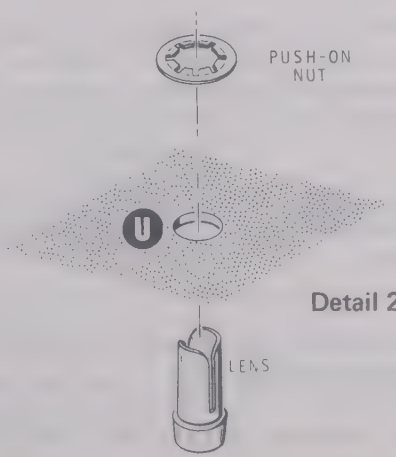
( ) Inspect the circuit board for solder bridges or unsoldered connections and set the circuit board aside until it is called for later.

FRONT PANEL ASSEMBLY

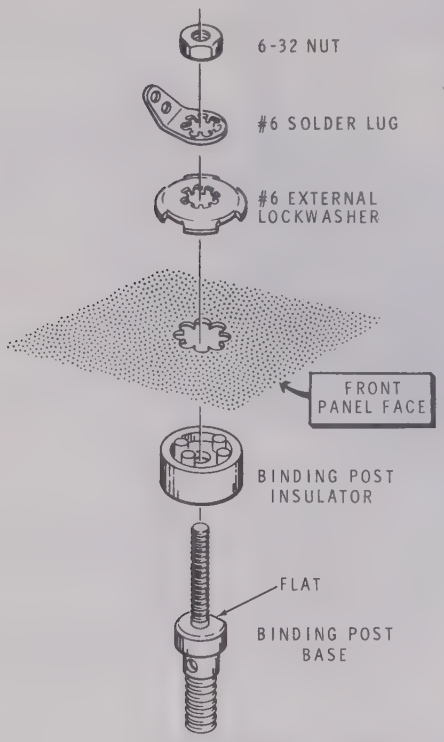
Refer to Pictorial 2-1 (fold-out from Page 6) for the following steps.

( ) Locate the front panel and position it as shown.

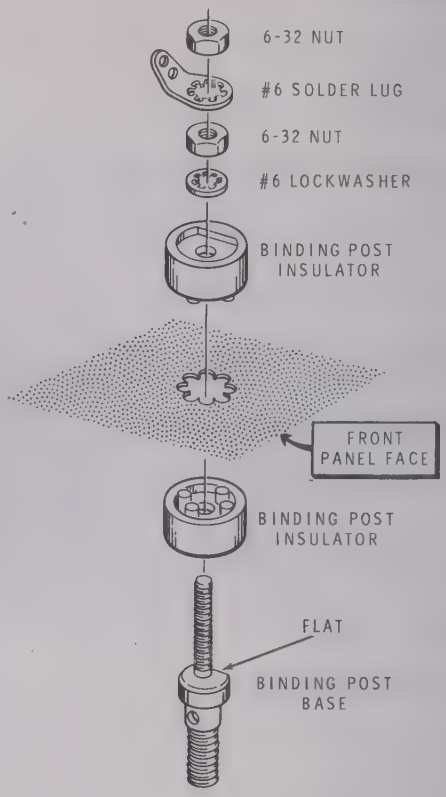
( ) Refer to Detail 2-1A and install a lens at U with a push-on nut as shown.



Detail 2-1A



Detail 2-1B



Detail 2-1C

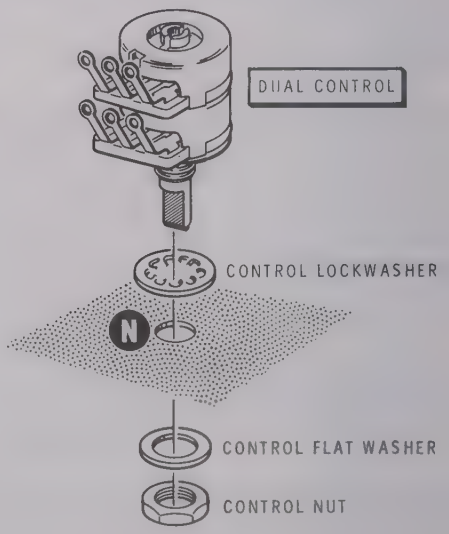
NOTE: The Heath Company has provided a plastic nut starter with this kit. Use this nut starter to hold and start 6-32 nuts on screws.

( ) Refer to Detail 2-1B and mount a binding post base at locations A, C, H, and R. Use large external lockwashers and position the solder lugs as shown; position the flat on the binding post base down.

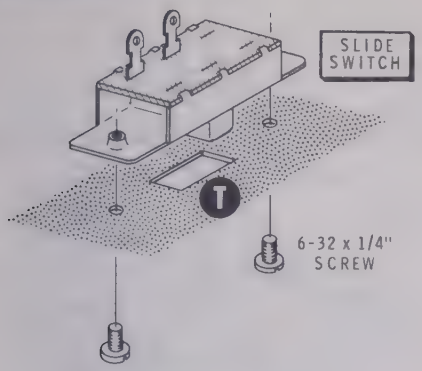
( ) Refer to Detail 2-1C and mount the remaining binding post bases at B, D, G, J, and S. Position the solder lugs as shown.

( ) Mount a dual control at N as shown in Detail 2-1D. Use control hardware.

( ) In the same manner, mount a 2000 Ω control at L.



Detail 2-1D



Detail 2-1E

( ) Refer to Detail 2-1E and mount a slide switch at T. Use 6-32 x 1/4" screws. Position the switch with the lugs nearest the lamp.

( ) Refer to Detail 2-1F and mount a 7-lug rotary switch (#63-444) at P in the position shown. Use control hardware. Then bend the control solder lug to touch lug 6 and solder them together.

( ) Prepare two 2" white wires.

( ) Connect a 2" white wire from lug 1 (NS) to lug 6 (S-1) of dual control N.

( ) Connect a 2" white wire from lug 3 (S-1) to lug 4 (NS) of dual control N.

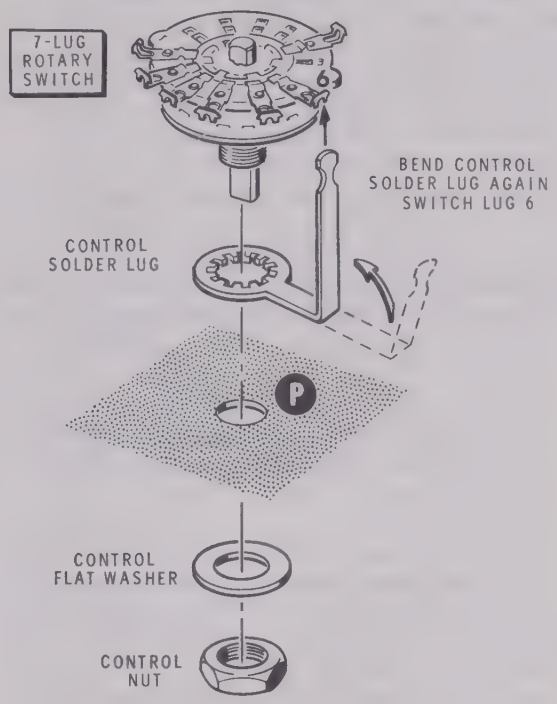
( ) Cut and place a 1" length of sleeving on each lead of a 10 kΩ (brown-black-orange) resistor.

( ) Connect one resistor lead to lug 1 of dual control N (S-2) and connect the other lead to solder lug H (NS). NOTE: Use the hole in the solder lug that is nearest the chassis.

NOTE: In the following steps, do not overlap the capacitor leads as you connect them to solder lug P. See the inset drawing on Pictorial 2-1 (fold-out from Page 6).

( ) Cut and place a 1" length of sleeving on a .01 μF disc capacitor lead.

( ) Connect the capacitor lead with sleeving to lug 2 of dual control N (NS) and connect the other lead to the control solder lug on switch P (NS).



Detail 2-1F

( ) Cut and place a 1" length of sleeving on a .01 μF disc capacitor lead.

( ) Connect the capacitor lead with sleeving to lug 5 of dual control N (NS) and connect the other lead to control solder lug P (NS).

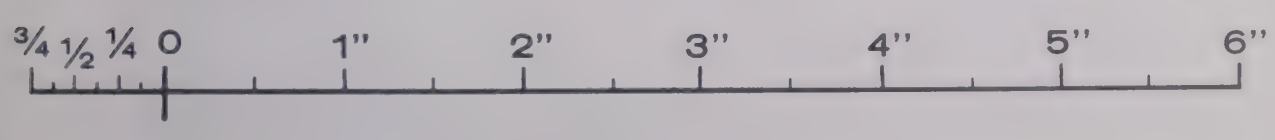
( ) Connect a .05 μF disc capacitor from lug 1 of switch P (S-1) to control solder lug P (NS).

( ) Connect a .01 μF disc capacitor from lug 2 of switch P (S-1) to control solder lug P (NS).

( ) Connect a .005 μF disc capacitor from lug 3 of switch P (S-1) to control solder lug P (NS).

( ) Connect a .001 μF disc capacitor from lug 4 of switch P (S-1) to control solder lug P (NS).

( ) Connect a 47 pF capacitor from lug 1 (NS) to lug 2 (NS) of control L.



Refer to Detail 2-1G (fold-out from Page 6) for the following five steps.

( ) Refer to Part 1 and cut the leads of the neon lamp to a length of 3/4".

( ) Refer to Part 2 and insert the lamp as far as it will go into the lens at U.

( ) Position the terminal collar as shown in Part 3, and push the collar onto the lens until the ends of the collar and lens are flush with each other as shown in Part 4.

( ) Refer to Part 4 and connect one lamp lead to lug 1 (NS) and the other lamp lead to lug 3 (NS) of the terminal collar.

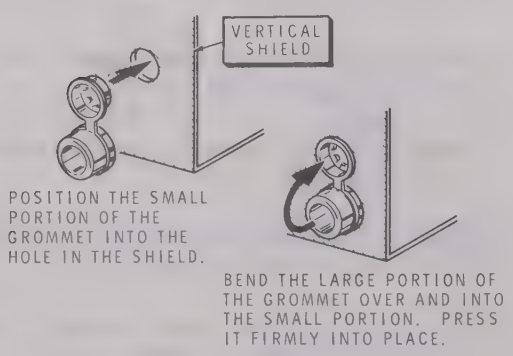
( ) Refer to Part 5 and connect a 27 kΩ (red-violet-orange) resistor between lug 2 (NS) and lug 3 (S-2) of the terminal collar. Cut off any excess lead lengths.

( ) Set the front panel aside until it is called for later.

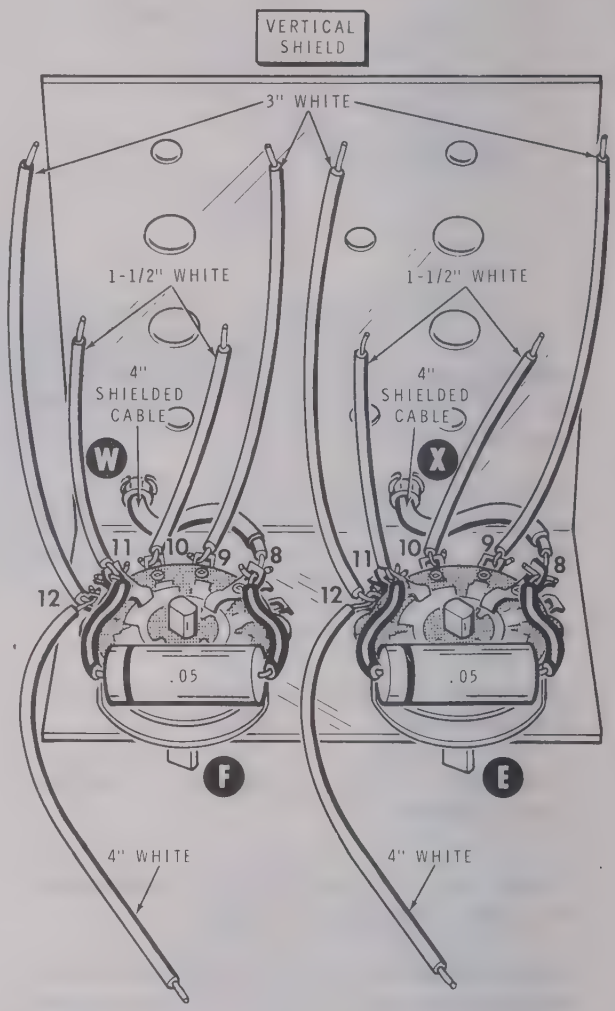
VERTICAL SHIELD ASSEMBLY

Refer to Pictorial 2-2 for the following steps.

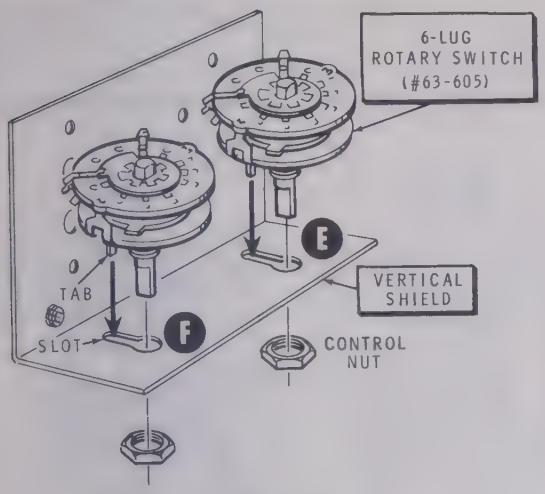
( ) Locate the vertical shield and insert grommets at W and X as shown in Detail 2-2A.


VERTICAL SHIELD
POSITION THE SMALL PORTION OF THE GROMMET INTO THE HOLE IN THE SHIELD.
BEND THE LARGE PORTION OF THE GROMMET OVER AND INTO THE SMALL PORTION. PRESS IT FIRMLY INTO PLACE.

Detail 2-2A



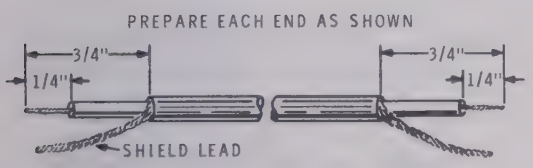
PICTORIAL 2-2



Detail 2-2B

( ) Refer to Detail 2-2B and temporarily mount 6-lug rotary switches at E and F. Use a control nut, match the tab to the slot, and tighten the nuts finger tight.

( ) Refer to Detail 2-2C and prepare two 4" lengths of shielded cable.



Detail 2-2C

( ) Cut the shield lead from one end of each cable. Connect this end of each cable in the following steps; the end with the shield lead will be connected later.

( ) Insert the end of a shielded cable without the shield lead through grommet X from the side oposite the switches. Connect the center lead to lug 8 (NS) of switch E.

( ) Insert the end of a shielded cable without the shield lead through grommet W from the side opposite the switches. Connect the center lead to lug 8 (NS) of switch F.

( ) Prepare the following lengths of white wire:

QUANTITY	LENGTH
4	3"
4	1-1/2"
2	4"

NOTE: In the following steps, switches E and F will be wired. Therefore, two rows of checkoff spaces are provided, one row for each switch.

( ) ( ) Connect a 3" wire to lug 9 of the switch (S-1).

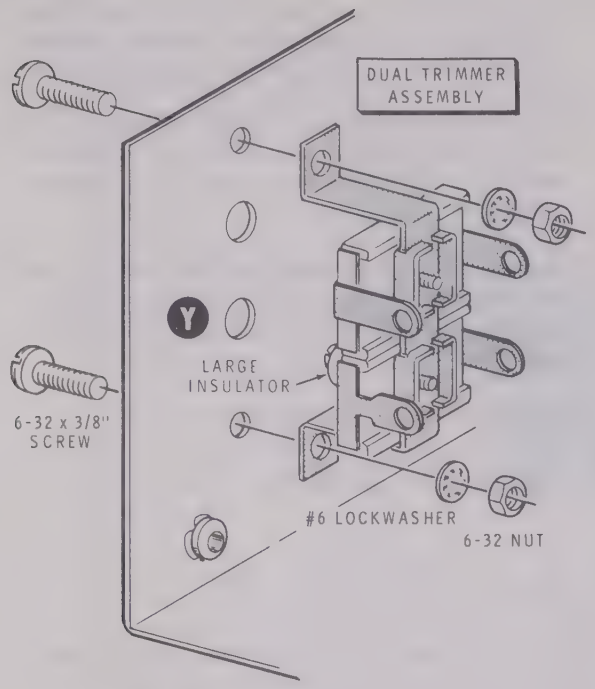
( ) ( ) Connect a 1-1/2" wire to lug 10 of the switch (S-1).

( ) ( ) Connect a 1-1/2" wire to lug 11 of the switch (NS). Pass the wire through both lugs.

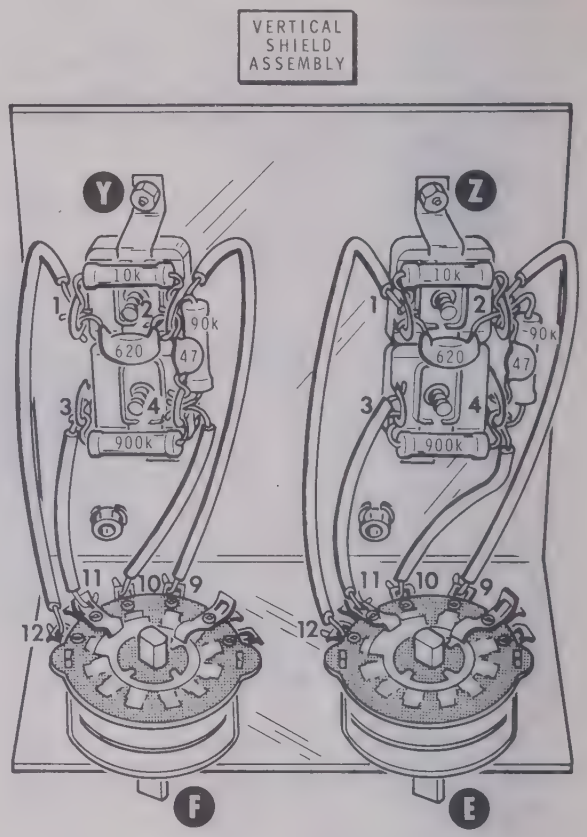
( ) ( ) Connect a 3" wire to lug 12 of the switch (NS).

( ) ( ) Connect a 4" wire to lug 12 of the switch (S-2).

( ) ( ) Cut and place a 1" length of sleeving on each lead of a .05 μF paper capacitor. Connect the lead from the banded end of the capacitor to lug 11 (S-2) and the other lead to lug 8 (S-2) of the switch as shown.



Detail 2-3A



PICTORIAL 2-3

Refer to Pictorial 2-3 for the following steps.

( ) Mount a dual trimmer assembly at Y as shown in Detail 2-3A. Use 6-32 x 3/8" screws and position the large insulator toward the switch.

( ) In the same manner, mount a dual trimmer assembly at Z.

NOTE: Perform the following steps twice. Once for each dual trimmer assembly.

( ) ( ) Connect a 900 kΩ, precision resistor from lug 3 (NS) to lug 4 (NS) of the dual trimmer. Position the resistor clear of the adjusting screw.

( ) ( ) Connect a 90 kΩ, precision resistor from lug 2 (NS) to lug 4 (NS) of the dual trimmer.

( ) ( ) Connect a 47 pF disc capacitor from lug 2 (NS) to lug 4 (NS) of the dual trimmer.

( ) ( ) Connect a 10 kΩ, precision resistor from lug 1 (NS) to lug 2 (NS) of the dual trimmer. Position the resistor clear of the adjusting screw.

( ) ( ) Connect a 620 pF capacitor from lug 1 (NS) to lug 2 (NS) of the dual trimmer. Position the capacitor clear of the adjusting screw.

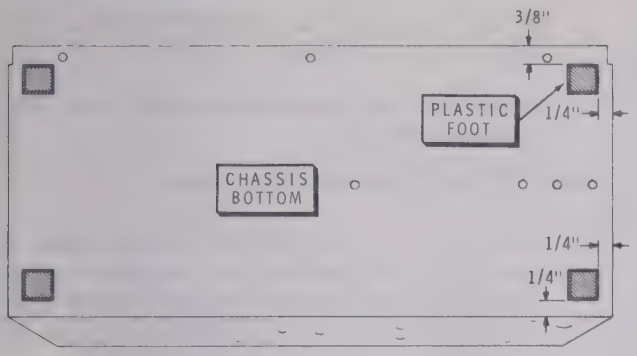
( ) ( ) Connect the end of the 3" white wire coming from lug 12 of the switch to lug 1 of the dual trimmer (S-3).

( ) ( ) Connect the end of the white wire coming from lug 11 of the switch to lug 3 of the dual trimmer (S-2).

( ) ( ) Connect the end of the white wire coming from lug 10 of the switch to lug 4 of the dual trimmer (S-4).

( ) ( ) Connect the end of the white wire coming from lug 9 of the switch to lug 2 of the dual trimmer (S-5).

( ) Set this vertical shield assembly aside until called for later.



Detail 2-4A

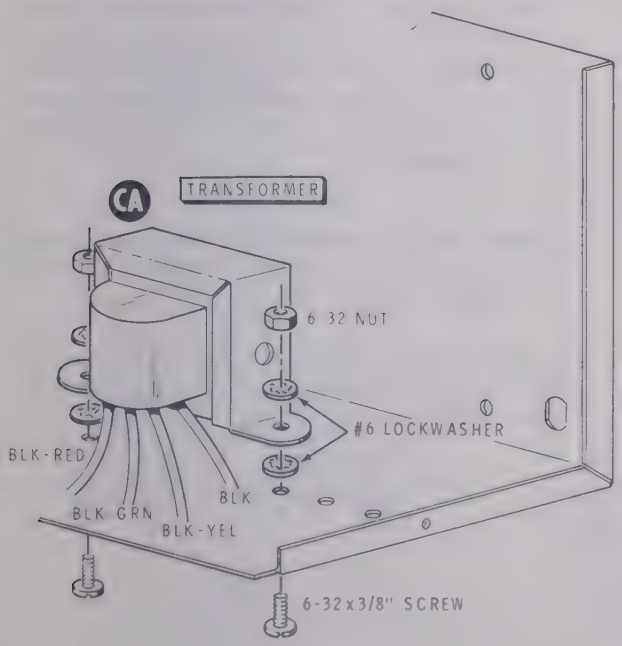
CHASSIS ASSEMBLY

Refer to Pictorial 2-4 (fold-out from Page 19) for the following steps.

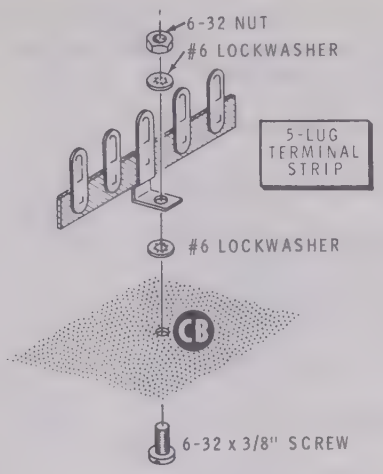
( ) Locate the chassis and install a plastic foot on the bottom side, at each corner, as shown in Detail 2-4A.

NOTE: Two lockwashers will be used to mount the following components; one between the mounting surface and the component, and the other under the nut.

( ) Position the chassis as shown and mount a transformer on the chassis bottom at CA with the leads as shown. Use 6-32 x 3/8" hardware. See Detail 2-4B.



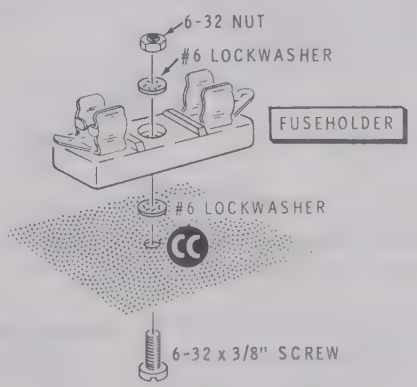
Detail 2-4B



Detail 2-4C

( ) Refer to Detail 2-4C and mount the terminal strip at CB. Use 6-32 x 3/8" hardware.

( ) Refer to Detail 2-4D and mount the fuseholder at CC with 6-32 x 3/8" hardware. Caution: Tighten the fuseholder securely in a position parallel to the chassis edge as shown.



Detail 2-4D

Locate the circuit board and connect the transformer leads as shown in Pictorial 2-4 (fold-out from Page 19). Solder each lead as it is connected.

( ) Either red lead to hole DD.

( ) Other red lead to hole FF.

( ) Red-yellow lead to hole EE.

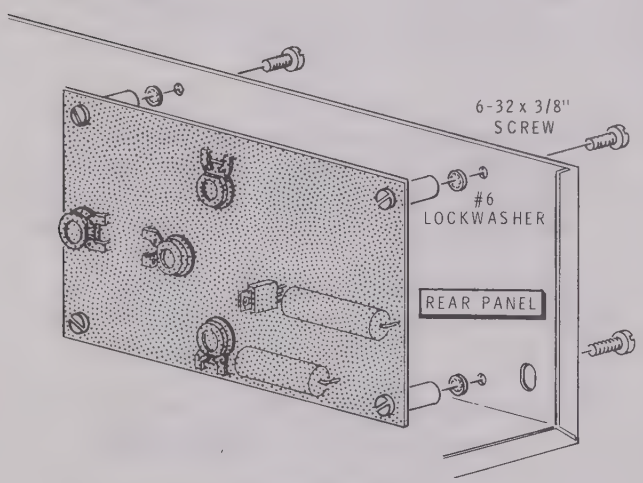
( ) Either blue lead to hole AA.

( ) Other blue lead to hole CC.

( ) Blue-white lead to hole BB.

( ) Cut off the excess lead lengths.

( ) Refer to Detail 2-4E and mount the circuit board on the chassis rear panel with 6-32 x 3/8" hardware.



Detail 2-4E

( ) Connect the black lead of the transformer to lug 1 (NS) of terminal strip CB.

( ) Connect the black-green transformer lead to lug 2 (NS) of terminal strip CB.

( ) Connect the black-yellow transformer lead to lug 4 (NS) of terminal strip CB.

( ) Connect the black-red transformer lead to lug 5 (NS) of terminal strip CB.

Refer to Pictorial 2-5 for the following steps.

( ) Mount the front panel to the chassis as shown in Detail 2-5A. Position the lip at the bottom of the front panel under the front edge of the chassis. Start each of the 6-32 x 3/8" screws and then tighten the hardware.

( ) Mount a 2000 Ω control at K. Use a control lockwasher, a control flat washer, and a control nut.

( ) Connect a 47 pF capacitor from lug 1 (NS) to lug 2 (NS) of control K.

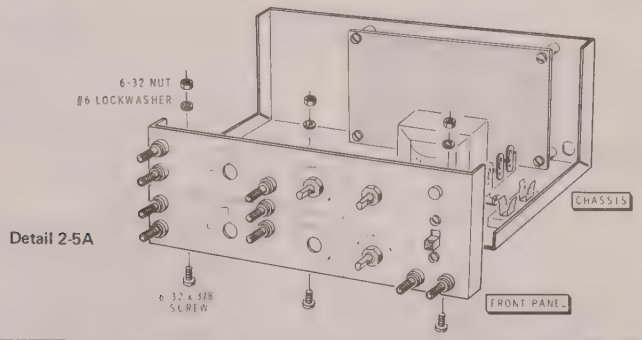
( ) Position the circuit board as shown and connect the center lead of the shielded cable coming from circuit board hole K to lug 2 of control K (S-2). Connect the shield lead to lug 1 of control K (S-2).

( ) Connect the center lead of the shielded cable coming from circuit board hole R to solder lug S (S-1). Connect the shield lead to solder lug R (S-1).

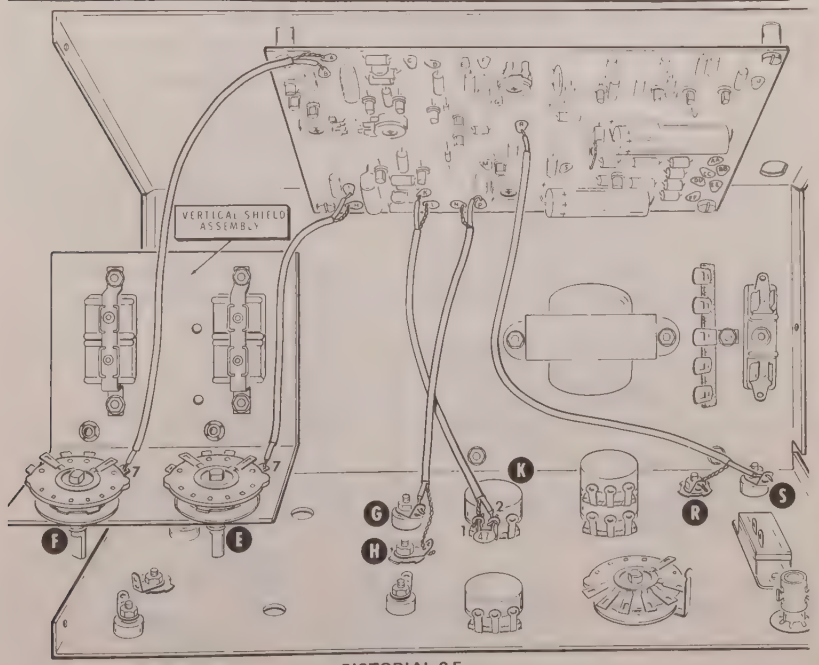
( ) Connect the center lead of the shielded cable coming from circuit board hole P to solder lug G (S-1). Connect the shield lead to solder lug H (S-2). NOTE: Use the hole in the solder lug that is nearest the chassis, and do not allow solder to run into the other hole of the solder lug.

( ) Connect the center lead of the shielded cable coming from circuit board hole J to lug 7 of switch E (S-1). Cut off the shield lead.

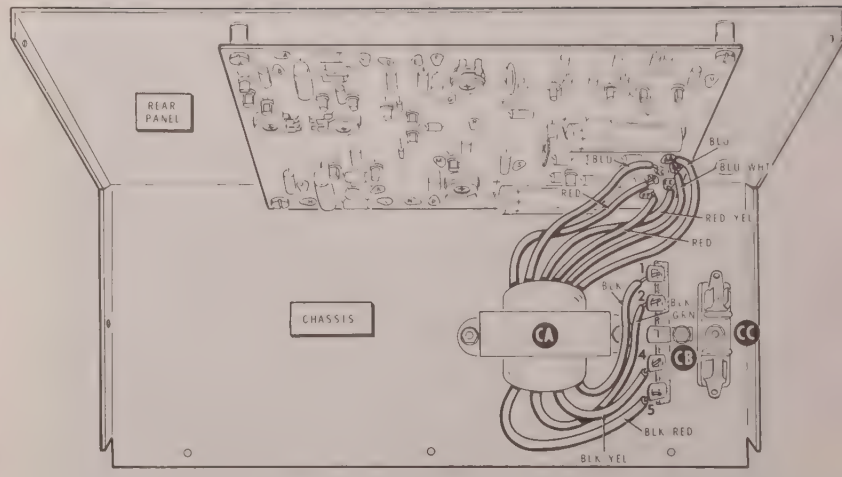
( ) Connect the center lead of the shielded cable coming from circuit board hole B to lug 7 of switch F (S-1). Cut off the shield lead.



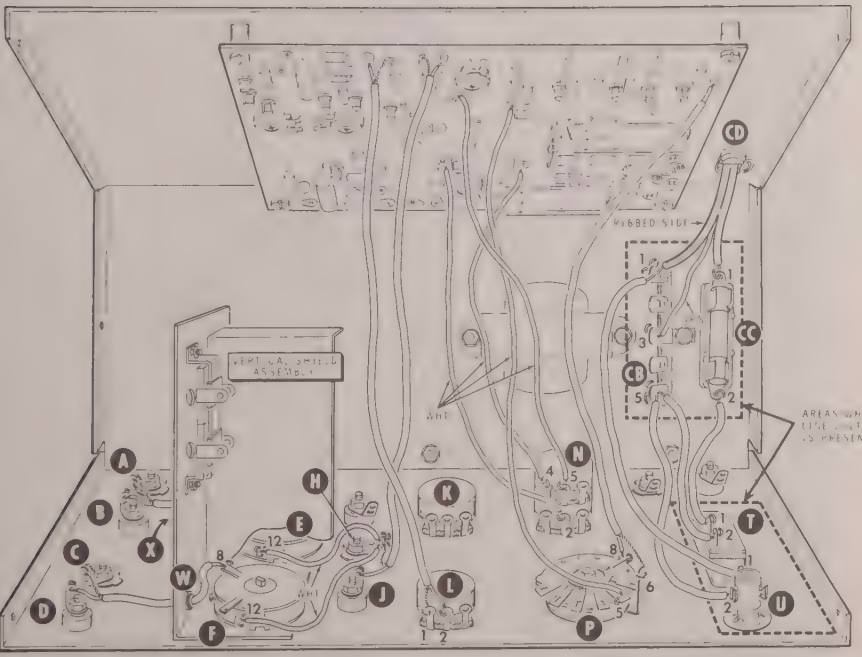
Detail 2-5A



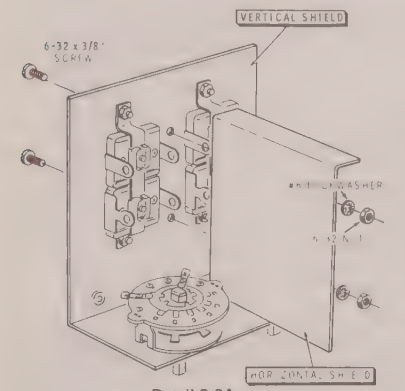
PICTORIAL 2-5



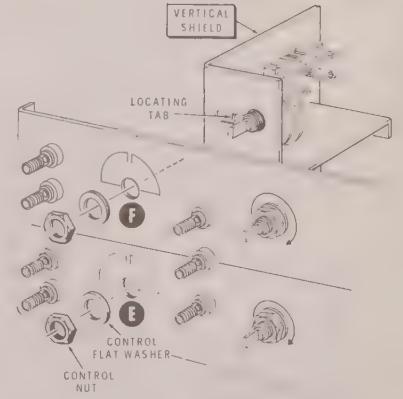
PICTORIAL 2-4



PICTORIAL 2-6



Detail 2-6A



Detail 2-6B

Refer to Pictorial 2-6 for the following steps.

( ) Mount the horizontal shield on the vertical shield as shown in Detail 2-6A. Use 6-32 x 3/8" hardware. Position the wires away from the area as shown in Pictorial 2-6.

( ) Refer to Detail 2-6B and mount the vertical shield assembly at E and F. Remove the control nuts and position the switch shafts through the front panel with the locating lugs in the shield slot. Use a control flat washer and a control nut. Do not pinch the cable or let the capacitor lead touch the chassis.

( ) Connect the center lead of the shielded cable coming from grommet X to solder lug B (S-1). Connect the shield lead to solder lug A (S-1).

( ) Connect the center lead of the shielded cable coming from grommet W to solder lug D (S-1). Connect the shield lead to solder lug C (S-1).

( ) Connect the white wire coming from circuit board hole M to lug 2 of dual control N (S-2).

( ) Connect the white wire coming from circuit board hole S to lug 4 of dual control N (S-2).

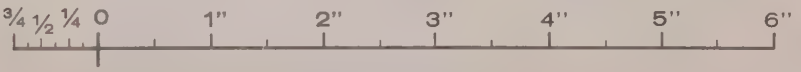
( ) Connect the white wire coming from circuit board hole G to lug 5 of dual control N (S-2).

( ) Connect the white wire coming from circuit board hole T to lug 5 of switch P (S-1).

( ) Connect the white wire coming from lug 12 of switch E to solder lug H (NS).

( ) Connect the white wire coming from lug 12 of switch F to solder lug H (NS).

( ) Connect the center lead of the shielded cable coming from circuit board hole F to solder lug J (S-1). Connect the shield lead to solder lug H (S-3).



( ) Connect the center lead of the shielded cable coming from circuit board hole C to lug 2 of control L (S-2). Connect the shield lead to lug 1 of control L (S-2).

( ) Connect the center lead of the shielded cable coming from hole U to lug 8 of switch P (S-1). Connect the shield lead to the solder lug of switch P (S-7). Be sure all of the leads are soldered.

ALTERNATE LINE VOLTAGE WIRING

Two sets of wiring instructions are given below, one for 120 Vac line voltage and the other for 240 Vac line voltage. Use only the instructions that agree with the line voltage in your area. (In the U.S.A. 120 Vac is most often used, while in foreign countries 240 Vac is more common.)

120 Vac Wiring

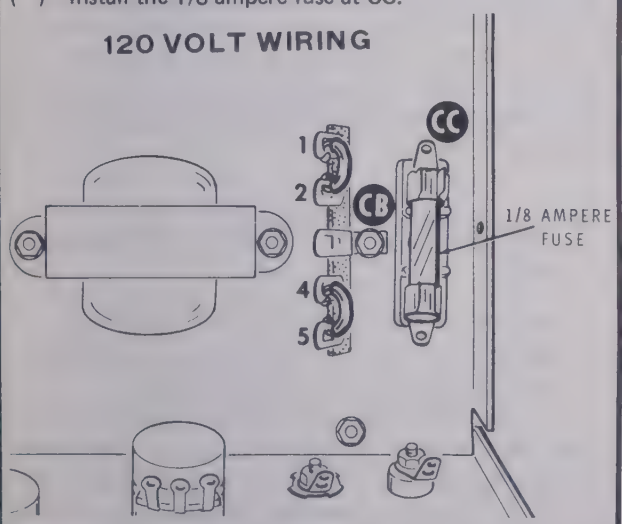
Refer to Detail 2-6C for the following steps.

( ) Cut and prepare the ends of two 1" lengths of brown wire. Melt a small amount of solder on the bare wire ends to hold the small wire strands together.

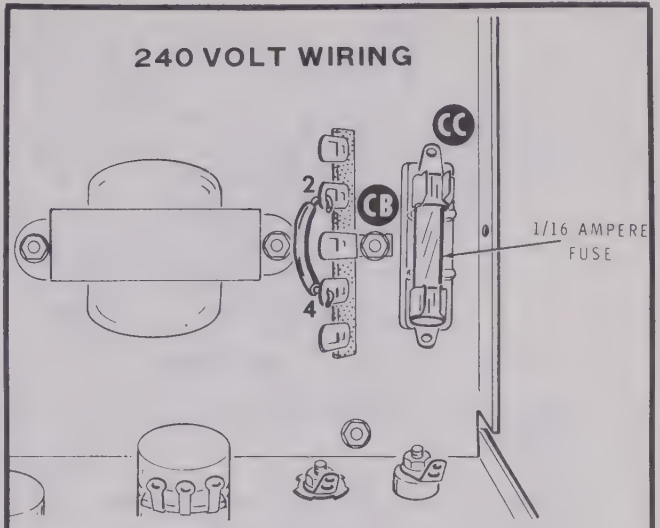
( ) Connect a 1" brown wire from lug 1 (NS) to lug 2 (S-2) of terminal strip CB.

( ) Connect a 1" brown wire from lug 4 (S-2) to lug 5 (NS) of terminal strip CB.

( ) Install the 1/8-ampere fuse at CC.



Detail 2-6C



Detail 2-6D

240 Vac Wiring

Refer to Detail 2-6D for the following steps.

( ) Prepare both ends of a 1-1/2" brown wire. Melt a small amount of solder on the bare wire ends to hold the small wire strands together.

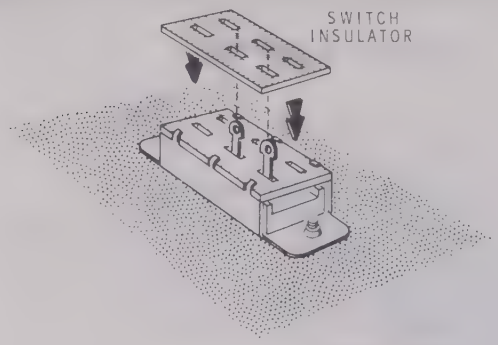
( ) Connect this wire from lug 2 (S-2) to lug 4 (S-2) of terminal strip CB.

( ) Install a 1/16-ampere fuse (not furnished with the kit) at CC.

FINAL WIRING

( ) Prepare the following lengths of brown wire, and melt a small amount of solder on the bare wire ends to hold the small wire strands together.

2-1/2"
2"
3-1/2"
4-1/2"



Detail 2-6E

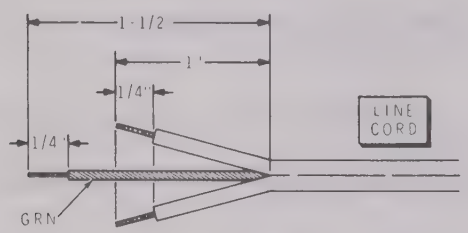
( ) Refer to Detail 2-6E and place the switch insulator on switch T.

( ) Connect a 2-1/2" brown wire from fuseholder lug 2 (S-1) to lug 1 of switch T (S-1).

( ) Connect a 2" brown wire from lug 5 of terminal strip CB (NS) to lug 2 of switch T (S-1).

( ) Connect a 3-1/2" brown wire from lug 5 of terminal strip CB (S-4) to lug 2 of terminal collar U (S-2).

( ) Connect a 4-1/2" brown wire from lug 1 of terminal strip CB (NS) to lug 1 of terminal collar U (S-2).



Detail 2-6F

( ) Refer to Detail 2-6F and prepare the line cord as shown. Melt a small amount of solder on the bare wire ends to hold the small wire strands together.

NOTE: The line cord supplied with this kit has one of its outer wires marked with a rib in the insulation along its edge. The other wire is smooth, and the third wire is color coded green. It is very important that you connect the ribbed wire as indicated.

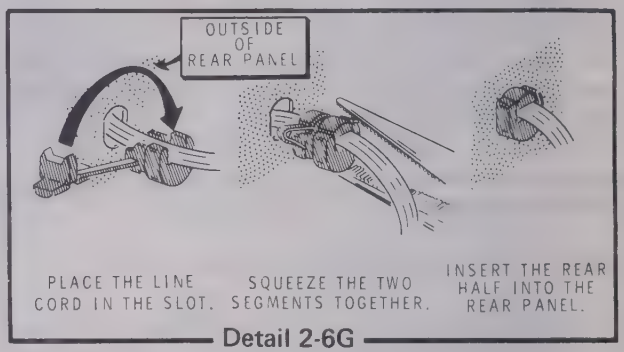
( ) Insert the prepared end of the line cord through hole CD and connect the green wire to lug 3 of terminal strip CB (S-1).

( ) Connect the line cord ribbed side to lug 1 of terminal strip CB (S-4).

( ) Connect the smooth wire to lug 1 of the fuseholder CC (S-1).

( ) Be sure no primary wiring is closer than 1/8" to the chassis or other conductors.

( ) Refer to Detail 2-6G and install the strain relief on the line cord at CD as shown.



Detail 2-6G

KNOB INSTALLATION

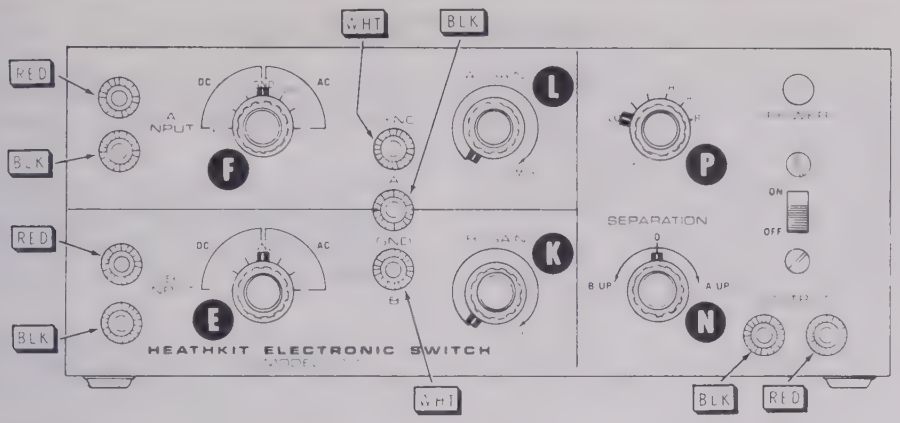
Refer to Pictorial 2-7 and Detail 2-7A for the following steps.

Refer to Detail 2-7A and notice that the knob bushing is tapered. Be sure, in the next step, to place this bushing on the shaft with the small end facing out, or the knob will not slide onto it. (Roll the bushing on a flat surface if you are unsure about it; the bushing will gradually turn toward the small end.)

( ) Install knob bushings on the shafts at E, F, L, K, N, and P.

( ) Mount the binding post caps. Note the correct color callouts in the boxes around Pictorial 2-7.

NOTE: Since bushings are used in the switch and control knobs, the knob pointers must be aligned to the panel screen before the knobs are pressed on bushings. Replace each knob on its original shaft whenever you remove a knob. Be sure the knob pointers are aligned properly before pressing the bushing all the way into the knob, as removal of the bushing is difficult.



PICTORIAL 2-7

NOTE: When installing knobs on the knob bushings in the following steps:

1. Press the knob part way onto the bushing with the knob pointer positioned as shown in Pictorial 2-7.

2. Carefully remove the knob and bushing, being sure the knob does not come off the bushing.

3. Refer to Detail 2-7A and push the bushing all the way into the knob with the handle of a screwdriver. Place the knob on a hard flat surface to do this.

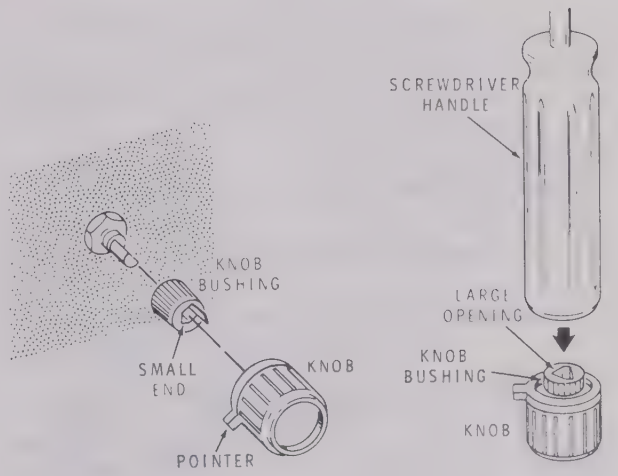
4. Reinstall the knob on its original switch or control shaft.

( ) Turn switch E to its center (GND) position and install a knob.

( ) Turn switch F to its center (GND) position and install a knob.

( ) Turn switch P fully counterclockwise and install a knob.

( ) Turn control N to the center (0) position and install a knob.



Detail 2-7A

( ) Turn control K fully counterclockwise and install a knob.

( ) Turn control L fully counterclockwise and install a knob.

This completes the wiring of your Heathkit Electronic Switch. Carefully inspect all connections for loose wires or unsoldered connections. Remove any wire clippings or solder splashes that may be lodged in the wiring. Then proceed to the "Adjustments" section.

ADJUSTMENTS

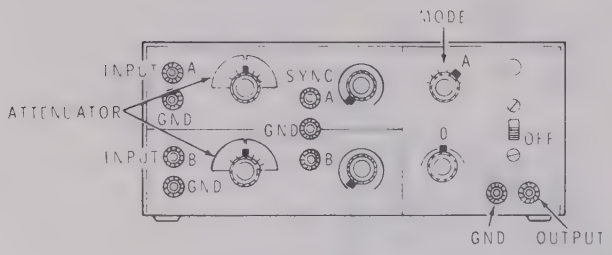


Figure 1

Refer to Figure 1 for the following steps.

( ) Set the POWER switch to OFF.

( ) Set both ATTENUATOR switches to GND.

( ) Set the A GAIN and B GAIN controls to a fully counterclockwise position.

( ) Set the SEPARATION control to midposition.

( ) Turn the MODE switch to A.

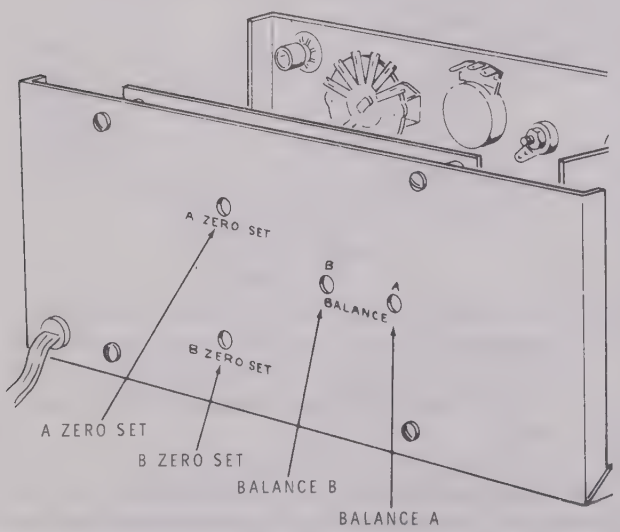


Figure 2

Refer to Figure 2 for the following steps.

( ) Using a small screwdriver, set the A ZERO SET and B ZERO SET controls (on the rear panel) to the midposition.

( ) Set the A BALANCE and B BALANCE controls fully counterclockwise (viewing from the rear).

WARNING: When the unit is plugged in and turned on, line voltage will be present at the points indicated in Pictorial 2-6 (fold-out from Page 20). Do not touch any bare connections in these areas.

( ) Insert the line cord plug of the Electronic Switch into the proper ac source (120 volts or 240 volts).

( ) Turn the Electronic Switch on.

NOTE: If you do not obtain the proper response in any of the following steps, turn the Electronic Switch off and refer to the "In Case of Difficulty" section. Then, after the trouble is corrected, complete the adjustments.

The Balance and Zero Set controls are very sensitive to adjust and the components are temperature sensitive. Therefore, in the following steps you will adjust these controls to preliminary settings. Final adjustments will be made with the cover on, after "Final Assembly."

ZERO SET AND BALANCE ADJUSTMENTS

Use only one of the following two sets of instructions. If you have a dc-coupled oscilloscope, use the "Adjustments Using a DC-Coupled Oscilloscope." If you have an ac-coupled oscilloscope, use the "Adjustments Using an Electronic voltmeter and an AC-Coupled Oscilloscope" on Page 25.

Adjustments Using a DC-Coupled Oscilloscope

Refer to Figure 2 for the following steps.

NOTE: If your oscilloscope has a switch for either ac or dc coupling, switch the oscilloscope to dc coupling. Use the 1-volt-per-centimeter range.

( ) Use the oscilloscope controls to center the trace vertically on the oscilloscope.

( ) Connect the shield or ground input of the oscilloscope to the black OUTPUT post of the Electronic Switch.

( ) Connect the vertical input of the oscilloscope to the red OUTPUT post of the Electronic Switch.

( ) Adjust the A ZERO SET to position the trace at 2.5 volts on a calibrated oscilloscope.

( ) Rotate the A GAIN control fully clockwise.

( ) Adjust the A BALANCE control clockwise (while you are facing the rear panel) to center the trace to approximately zero.

( ) Rotate the A GAIN control from minimum to maximum. If the trace moves, adjust the A BALANCE control until the trace remains stationary as the A GAIN control is rotated.

( ) If the trace is not centered vertically, adjust the A ZERO SET to center it, and repeat the preceding step.

( ) Set the Mode switch to position B.

( ) Adjust the B ZERO SET to position the trace at 2.5 volts on a calibrated oscilloscope.

( ) Rotate the B GAIN control fully clockwise.

( ) Adjust the B BALANCE control clockwise to center the trace to approximately zero.

( ) Rotate the B GAIN control from minimum to maximum. If the trace moves, adjust the B BALANCE control until the trace remains stationary as the B GAIN control is rotated.

( ) If the trace is not centered vertically, adjust the B ZERO SET to center it, and repeat the preceding step.

( ) Turn the Electronic Switch off.

Proceed to the "Attenuator Adjustments" on Page 26.

Adjustments Using an Electronic Voltmeter and an AC-Coupled Oscilloscope

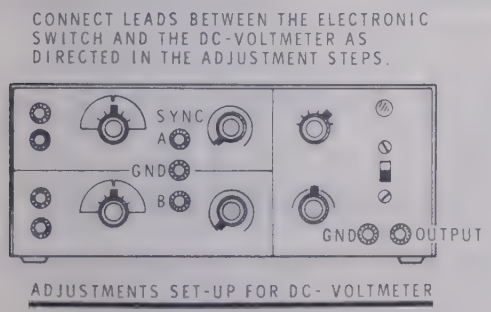


Figure 3

Refer to Figure 3 for the following steps.

NOTE: In the following steps, use the midscale zero if your voltmeter is so designed.

( ) Set the meter to the lowest range that is still capable of measuring +5 Vdc.

( ) Connect the voltmeter ground lead to the ground of the OUTPUT of the Electronic Switch.

( ) Connect the positive voltmeter lead to the OUTPUT of the Electronic Switch.

( ) Adjust the A ZERO SET to read 2.5 volts on the meter.

( ) Rotate the A GAIN control fully clockwise.

( ) Adjust the A BALANCE control clockwise to approximately zero volts.

( ) Rotate the A GAIN control from minimum to maximum. If the pointer moves, adjust the A BALANCE control until the pointer remains stationary as the A GAIN control is rotated.

( ) If the pointer is not on zero, adjust the A ZERO SET to position the pointer at zero.

( ) Set the MODE switch to B.

( ) Adjust the B ZERO SET to read 2.5 volts on the meter.

( ) Rotate the B GAIN control fully clockwise.

( ) Adjust the B BALANCE control clockwise to approximately zero volts.

( ) Rotate the B GAIN control from minimum to maximum. If the pointer moves, adjust the B BALANCE control until the pointer remains stationary as the B GAIN control is rotated.

( ) If the pointer is not on zero, adjust the B ZERO SET to position the pointer at zero.

( ) Turn the Electronic Switch off.

Proceed to the "Attenuator Adjustments."

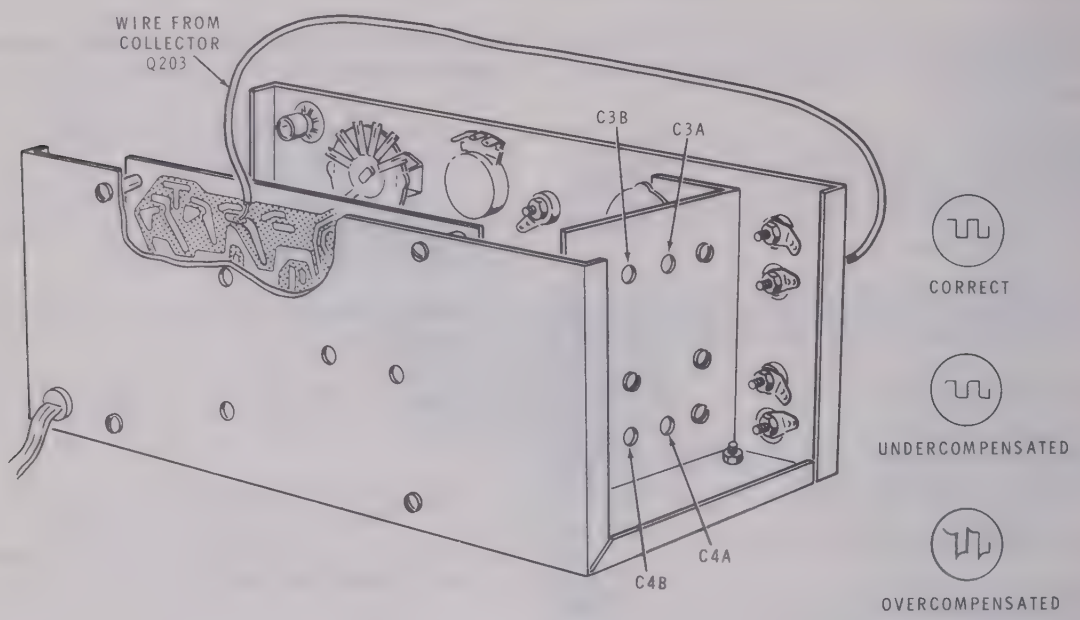


Figure 4

ATTENUATOR ADJUSTMENTS

Refer to Figure 4 for the following steps.

NOTE: The symmetry of the waveforms, in the following steps, may vary from the examples shown.

( ) Disconnect the wires from the output of the Electronic Switch. Connect the ground of the oscilloscope vertical input to the SYNC GND post of the Electronic Switch, and connect the vertical input of the oscilloscope to the SYNC A output.

( ) Connect the wire from the collector of Q203 to the A INPUT of the Electronic Switch.

( ) Set the oscilloscope to the 1-volt-per-centimeter range.

( ) Turn the Electronic Switch on.

( ) Set the MODE switch to HI.

( ) Set the A ATTENUATOR switch to 10 on the AC range.

( ) Set the A GAIN control for a desirable oscilloscope display.

( ) Adjust C3a to obtain a flat-topped square wave.

( ) Set the A ATTENUATOR switch to 100 AC.

( ) Increase the A GAIN control.

( ) Adjust C3b to obtain a flat-topped square wave.

( ) Disconnect the wire from the A INPUT and connect it to the B INPUT.

( ) Disconnect the wire from the SYNC A output and connect it to the SYNC B output.

( ) Set the B ATTENUATOR switch to 10 on the AC range.

( ) Set the B GAIN control for a desirable display.

( ) Adjust C4a to obtain a flat-topped square wave.

( ) Set the B ATTENUATOR switch to 100 AC.

( ) Increase the B GAIN control.

( ) Adjust C4b to obtain a flat-topped square wave.

( ) Rotate the MODE switch counterclockwise. There should be a different frequency square wave in each switch position.

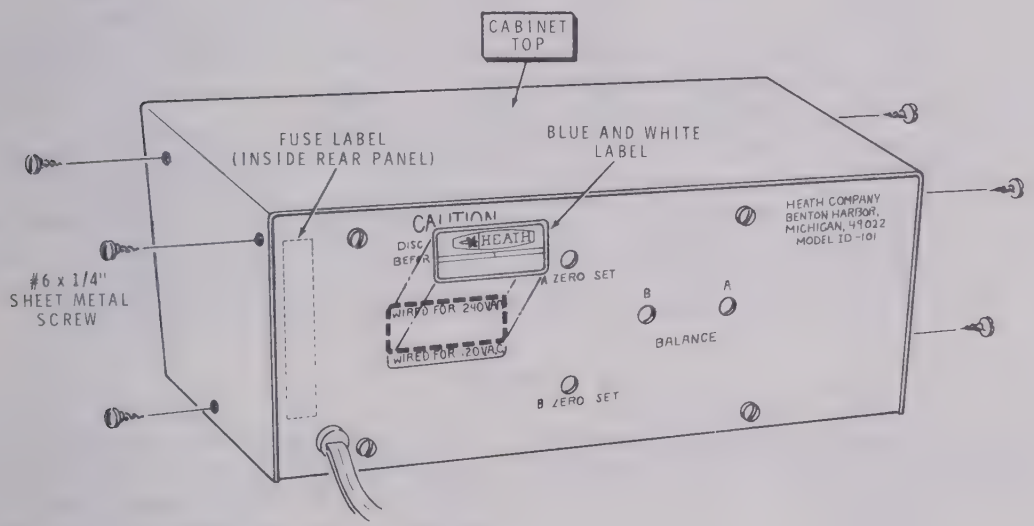
( ) Turn the Electronic Switch off and unplug the line cord from the ac source.

( ) Disconnect the wire from the collector of Q203 and the B INPUT.

( ) Disconnect the wire from the SYNC B output and GND.

This completes the "Adjustments." Proceed to "Final Assembly."

FINAL ASSEMBLY



PICTORIAL 2-8

Refer to Pictorial 2-8 for the following steps.

( ) In the space provided, write the proper fuse size and rating on the fuse label. (3AG, slow-blow, 1/8 A, for 120 V operation or 1/16 A for 240 V operation.) Carefully peel away the backing paper from the fuse label and press the label onto the inside rear panel above the line cord as shown.

( ) Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the rear chassis panel. Place the label to cover the voltage that does not apply. Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.

( ) Mount the cabinet top with six #6 x 1/4" sheet metal screws; position the overhang to the front.

( ) (Optional) Slightly spread the open end of each of the binding posts by inserting a phillips head screwdriver into it and then tap the screwdriver lightly. This will keep the binding post caps from coming off.

This completes the assembly of the Electronic Switch.

FINAL ADJUSTMENTS

( ) Plug the line cord into an ac source and turn the Electronic Switch on. Allow the unit to warm up at least 15 minutes. The warm-up with the cover on will stabilize the temperature drift for the final adjustments.

( ) Repeat the "Zero Set and Balance Adjustments." See Page 24.

NOTE: The "Zero Set and Balance Adjustments" should also be checked and adjusted periodically or when they appear to have drifted.

OPERATION

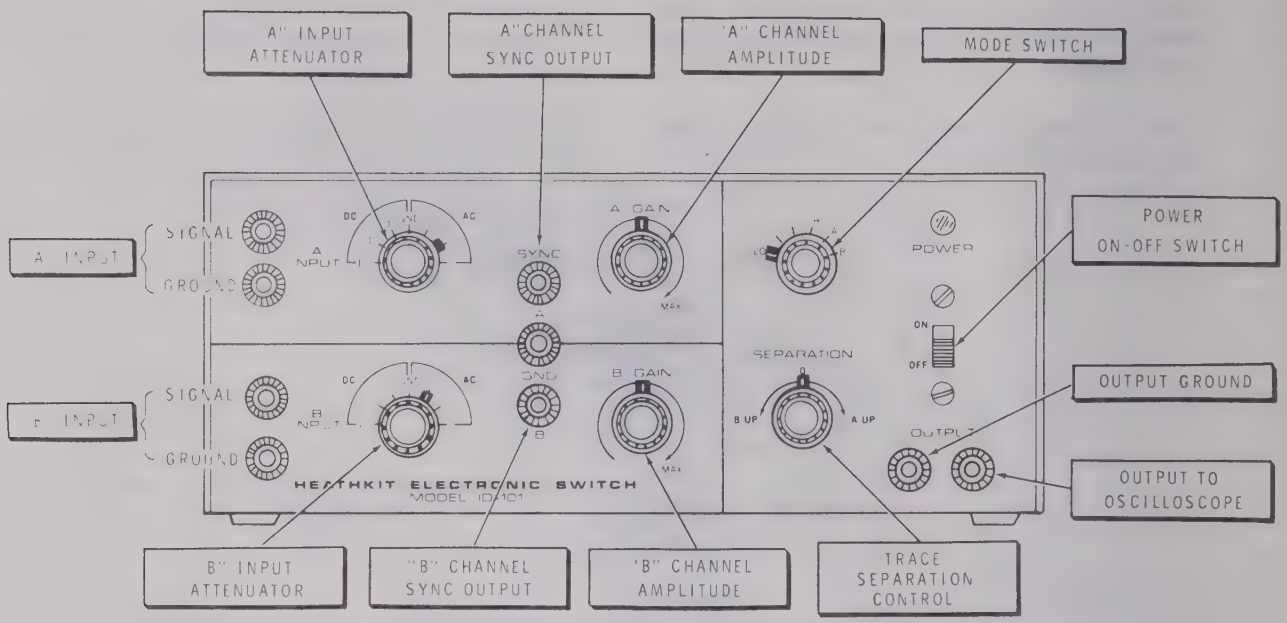


Figure 5

Refer to Figure 5 as you read the description of the inputs, outputs, controls and switch functions of the Electronic Switch.

Your Electronic Switch enables you to display two input signals simultaneously on a single-beam oscilloscope. One signal is modulated on the top and the other signal on the bottom of an internally-produced square wave. This dual-modulated square wave is then coupled from the OUTPUT terminals to the vertical input of an oscilloscope.

When the square wave is set to the proper frequency, the square wave does not appear and only the two modulating signals are shown on the screen. The relative positions of these two signals can be changed by the SEPARATION control, which effectively varies the amplitude of the square wave.

NOTE: On single-channel operation with an ac oscilloscope, set the SEPARATION control to 0 and position the trace vertically with the oscilloscope vertical position control.

The MODE switch sets the frequency of the square wave generator. Use the position that gives the least interference with the signal displayed. The A and B positions of the MODE switch select either the A or the B channel input signal for a single trace on the oscilloscope.

The INPUT ATTENUATOR switches adjust the input signal amplitude on both the DC and the AC ranges. The DC ranges of the ATTENUATOR switch (and the dc amplifier designed into this unit) allow you to use this Electronic Switch with a dc oscilloscope and to monitor both the ac signals and their dc operating level. On the AC ranges a capacitor is in series with the input, allowing you to block dc and couple only the ac signal to the oscilloscope. This could be very useful, for example, if you were measuring the ac ripple on a power supply.

The A and B GAIN controls adjust the trace amplitudes within the ATTENUATOR ranges to give a desired trace height on the oscilloscope.

The A or B SYNC output must be connected to the external sync input of the oscilloscope for dual trace applications.

The OUTPUT terminals of the Electronic Switch are connected to the vertical input of the oscilloscope.

To match the vertical input of the oscilloscope to the Electronic Switch OUTPUT, set the vertical amplitude controls of a calibrated oscilloscope to the 1 volt range. If your oscilloscope is not calibrated, the oscilloscope vertical input can be matched to the Electronic Switch OUTPUT in the following manner. Set the Electronic Switch controls as follows:

Attenuators – GND
Mode Switch – HI
Separation – Full clockwise

Adjust the vertical input of your oscilloscope until one trace is at the top and one trace is at the bottom of the screen.

Now that the oscilloscope is set to the proper range, use the Electronic Switch INPUT ATTENUATOR and GAIN controls in the same manner as you would use the corresponding oscilloscope controls. Use the dc attenuator ranges with a dc oscilloscope, to monitor both the input signals and the dc levels. Use the ac attenuator ranges to block dc voltages, so only the ac signals are coupled to the oscilloscope.

To calibrate this Electronic Switch - oscilloscope system, check the "Zero Set and Balance Adjustments" and repeat the adjustments if necessary. Then apply a signal of a known amplitude to the A INPUT of the Electronic Switch. Adjust the A INPUT ATTENUATOR and A GAIN of the Electronic Switch to obtain a representative display on the desired two calibrating lines on the grid of the oscilloscope. Repeat the process for the B INPUT channel. Once the GAIN controls are set and remain in this position, all attenuator ranges are calibrated to within ±3%.

CAUTION: All ground binding posts with black caps are connected to the chassis and power line ground. Do not make any power line connection to the black (ground) binding posts.

APPLICATIONS

Figure 6 illustrates typical equipment used with the Electronic Switch and their interconnections. The input signals to the Electronic Switch may be either "in-circuit" signals, as shown, or signals from a signal generator. In this example, the separate stereo outputs are applied to the separate channels of the Electronic Switch through low-capacitance coaxial cables with banana plugs, clips, or tinned leads. (All cables should be as short as possible.) The separate signals are shown simultaneously on the same time base.

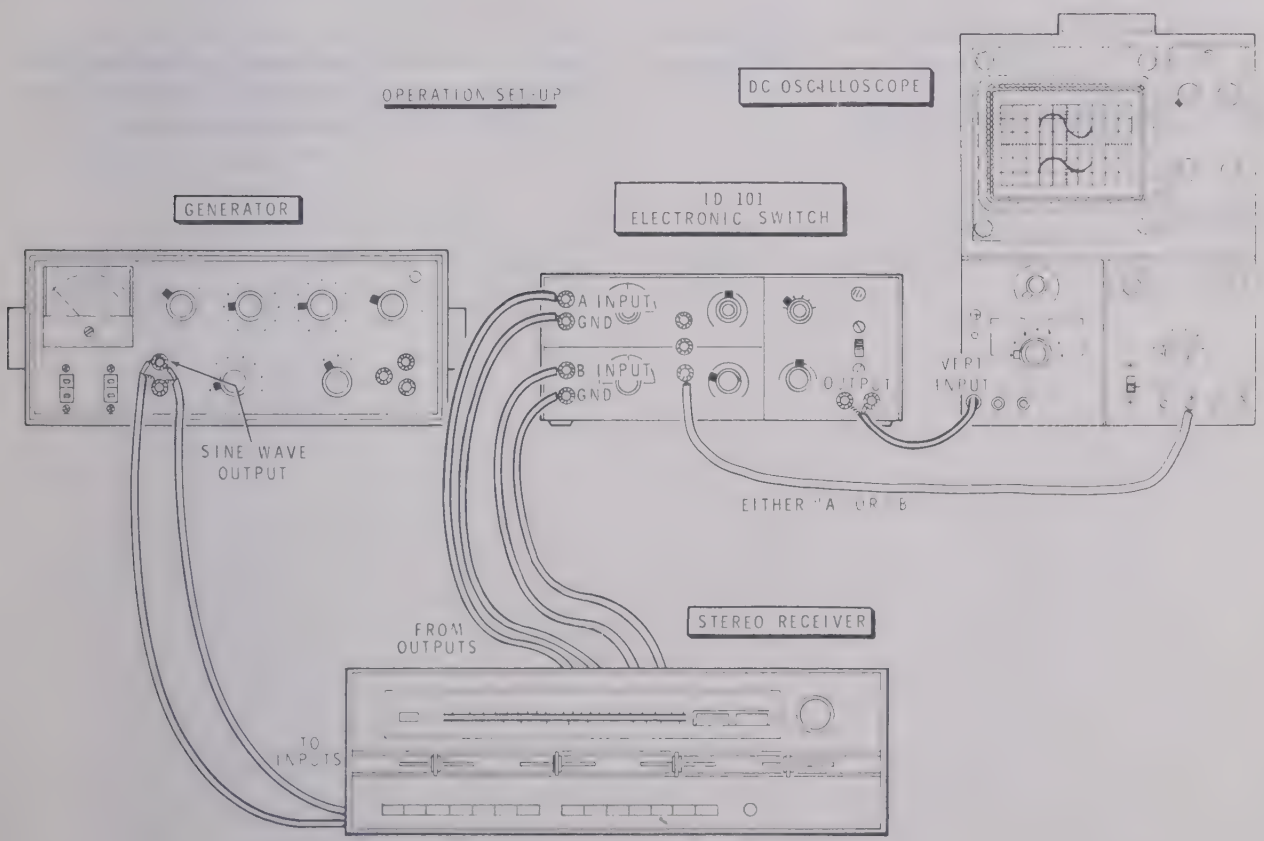


Figure 6

Comparing Two Signals

The following typical applications show several ways that the Electronic Switch can be used to compare two frequency related signals.

1. Comparing an input signal to an output signal, as in checking the gain of an audio amplifier stage.

2. Observing the phase relationship between two signals, such as input and output of a phase inverter or phase shifters.

3. Monitoring any two time-related signals from a digital circuit, such as the input and output signals from a frequency divider or the inputs to a stage of a counter circuit.

4. Locating and comparing hum or noise between channels or between any two stages of a stereo receiver (with or without a signal).

5. Making a cross-comparison between the waveforms from a known good circuit and the waveforms of a circuit under test, as in comparing circuits of two TV receivers tuned to the same station.

6. Comparing the outputs of the two channels of a stereo receiver or amplifier.

7. Comparing two dc voltage levels which vary during operation, such as plate and cathode voltages in transmitter keying.

NOTE: The A and B positions of the MODE switch allow you to monitor only one input signal at a time and to manually switch from one signal input to the other.

Other Uses

The Electronic Switch can also be used in combination with a voltmeter, with other test equipment, or even as an experimental part of a circuit in the following applications.

1. As an impedance matching coupler to match a high impedance circuit to a low impedance input.

2. As an alternate signal switch between signal inputs to a voltmeter or other test equipment, thus eliminating the necessity of changing test equipment leads from one signal to another.

3. For experimental applications, the Electronic Switch is useful as a preamplifier (with impedance matching capabilities) or as a square-wave generator.

IN CASE OF DIFFICULTY

Refer to the "Chassis Photographs" on Page 40 and "Circuit Board X-Ray Views" on Page 36 for help in locating parts.

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.

2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by carefully checking all connections to make sure they are soldered as described in the "Soldering" section of the "Kit Builders Guide."

3. Check the values of the parts. Be sure that the proper parts have been wired into each circuit. It would be quite easy, for example, to mistakenly install a 1000 Ω (brown-black-red) resistor where a 10 kΩ (brown-black-orange) resistor was called for.

4. Check electrolytic capacitors and diodes to be sure they are installed properly, with the marked end of each one positioned as it is shown in the Pictorial.

5. Check each transistor to be sure it is installed properly, with each lead going to the proper hole on the circuit board.

6. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring, or for solder bridges between foils on the circuit board.

7. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the "Voltage Chart" (Page 38) and Schematic (fold-out from Page 41). NOTE: All voltage readings were taken with a high impedance voltmeter. Voltages may vary as much as 20%.

8. Check transistors with a transistor tester or by substitution of transistors of the same types known to be good.

9. A review of the "Circuit Description" may also help you locate a difficulty.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover. Your Warranty is inside the front cover.

TROUBLESHOOTING

CAUTION: The full ac line voltage is present at the input wiring to the power transformer, and at the front panel lamp.

In using a voltmeter probe, or any other metal object in troubleshooting, be careful to touch only those points on the circuit board which are specified in the Voltage Charts.

Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE/POSSIBLE FAULTY COMPONENT
Unit inoperative, pilot lamp does not light.	1. Line cord or fuse open.
No output voltage from power supply.	1. Diodes D401, D402, D403, D404, D405, D406. 2. Transistors Q401, Q402.
Power supply voltage low (less than +20 V, −12 V supply OK).	1. Power transformer secondary wiring reversed.
DC Balance not possible on one channel (trace centered or dc Voltmeter pointer centered).	1. Transistors Q101, Q103: Channel A. Transistors Q102, Q104: Channel B.
DC Balance not possible on either channel.	1. +20 V or −12 V Power supply voltage low.
Zero Set adjustment cannot be made on either channel (trace centered or dc voltmeter pointer centered).	1. Transistors Q105, Q107, Q109, Q111, Q106, Q108, Q110, Q112.
Only one channel signal at output to oscilloscope.	1. Mode switch S2. 2. Transistors Q201, Q202, Q203, Q204, Q301, Q302.
Output signal, but no sync output to oscilloscope.	1. Transistors Q113, Q114. 2. Resistors R119, R120. 3. Capacitors C105, C106.

SPECIFICATIONS

Signal Frequency Response	DC-5 MHz +1-1/2 dB, –3 dB.
Signal Gain	Greater than 10 times.
Minimum Input Signal	50 mV.
Maximum Input Signal	600 Vdc or 600 Vac peak-to-peak.
Input Impedance	1 MΩ, 50 pF.
Maximum Signal Output	8 V peak-to-peak.
Output Loading	1000 Ω minimum resistance.
Hum and Noise (single channel only)	Less than 40 mV peak-to-peak.
Chopping Rates	Approximately 100, 500, 1000 and 5000 Hz.
Power Requirements	120/240 V, 50-60 Hz, 6 watts.
Dimensions	10-3/8" wide x 4-1/4" high x 5-3/16" deep.
Net Weight	3.5 lbs.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

Refer to the Block Diagram (below) and Schematic (fold-out from Page 41) while reading the following paragraphs.

The complete Electronic Switch consists of two input networks (input frequency-compensating networks and attenuator switches), two preamplifiers, a square wave generator, and a switching/output circuit. The preamplifiers are identical and have a signal gain of approximately 20 dB.

The outputs of the two preamplifiers are applied to opposite sides of the switching/output circuit. The output from the square wave generator alternately turns each side of the switching/output circuit on and off. Thus, the two input signals from the preamplifiers are alternately applied to the single Output jack. An input signal from either the A or B channel only may also be selected, if desired.

NOTE: Since the A and B channels are identical, only the A input network and preamplifier will be described in the following paragraphs.

ATTENUATOR AND PREAMPLIFIER

A signal at the A Input binding post is applied through the A Input Attenuator switch to the frequency-compensated attenuator network, which consists of R1, R3, R5, C3a, C5, C3b, and C7. C1 is used as a dc blocking capacitor for the ac switch positions.

From lug 7 of the Attenuator switch, the signal is coupled through R101 and C101, which provide current limiting and frequency compensation, to the gate of FET (field-effect transistor) Q101. Diodes D101 and D103 are connected between the gate of Q101 and ground in case a high input signal voltage is accidentally applied to the input.

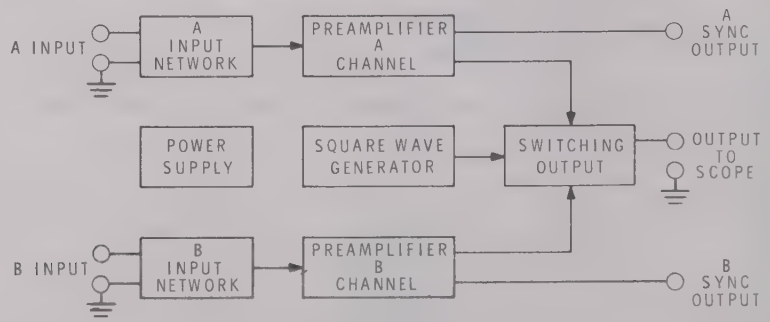
Transistor Q103 provides a constant current source for high input impedance transistor Q101, which is connected as a source follower. "A Balance" potentiometer R105 sets the bias for Q103, thus establishing the source of Q101 at zero volts.

From the source of Q101, the signal is coupled to the base of Q105, which is connected in a differential amplifier circuit with Q107. An adjustable constant current is supplied to this differential amplifier by Q109.

The differential amplifier enables the Gain and positioning (Separation, A Zero Set) controls to operate independently of each other. The gain of a differential amplifier is approximately equal to the collector resistance divided by the resistance between its two emitters. The gain is adjusted by R9, which is connected between the emitters of Q105 and Q107.

The dc voltage at the Output of the Electronic Switch (which controls the positioning on a dc oscilloscope) is controlled by the constant current supplied through Q109 to the differential amplifier. This current is adjusted by Separation control R7a and A Zero Set control R113, which change the bias on Q109. R113 is adjusted for zero voltage at the Output terminals when the Separation control is at zero. The dual Separation controls are wired so when channel A is positioned more positively, channel B is positioned more negatively.

From the collector of Q107, the signal is coupled through emitter follower Q111 and diode D301 to the switching/output circuit, and through emitter follower Q113 and C105 to the Sync A output terminal.



BLOCK DIAGRAM

SQUARE WAVE GENERATOR AND DRIVERS

The square wave generator is composed of Q201, Q202, and their associated circuit components, which are connected as an astable multivibrator. The multivibrator frequency is determined by the Mode switch, which selects one of the four charging capacitors. The Mode switch can also be used to hold the multivibrator in either one of its two stable states (in position A, Q202 remains cut off; in position B, Q202 conducts and Q201 remains cut off).

From the collector of Q202, the square wave output of the multivibrator is coupled through R208 to the base of driver transistor Q203. On the negative half cycle, Q203 conducts. Therefore, the positive voltage that occurs at its collector holds Q204 in cutoff and is coupled through R302 as a gating voltage to the base of Q302.

When the positive half-cycle of the square wave is applied to its base, Q203 is cut off. This causes Q204 to conduct and apply a gating voltage to the base of Q301.

SWITCHING/OUTPUT STAGE

Q301 and Q302, the switching/output transistors, are alternately turned on and off by the 180 degree out-of-phase square waves at their bases. The rate at which they are turned on and off is determined by the square wave frequency. Since the two halves of the circuit are identical, only one of the two alternate operating states will be explained below.

Refer to Figure 7, Condition #1.

When Q204 conducts, approximately +20 volts is developed at its collector. Approximately +12 volts is at point A. This forward biases D301, allowing the signal from the "A preamplifier" to be applied to the base of Q301. Q301 is also biased on by the same dc voltage, causing approximately +12 volts to appear at its emitter.

12 volt zener diode D303 acts as a level translator. Therefore, the no-signal voltage at the Output terminal will be zero.

During this time, Q302 is cut off by the +12 volts at its emitter and by the zero volts that occurs at its base while Q203 is cut off. This zero voltage also holds D302 cut off and blocks the signal from the "B preamplifier."

The alternate operating state of this circuit is shown in Figure 7, Condition #2.

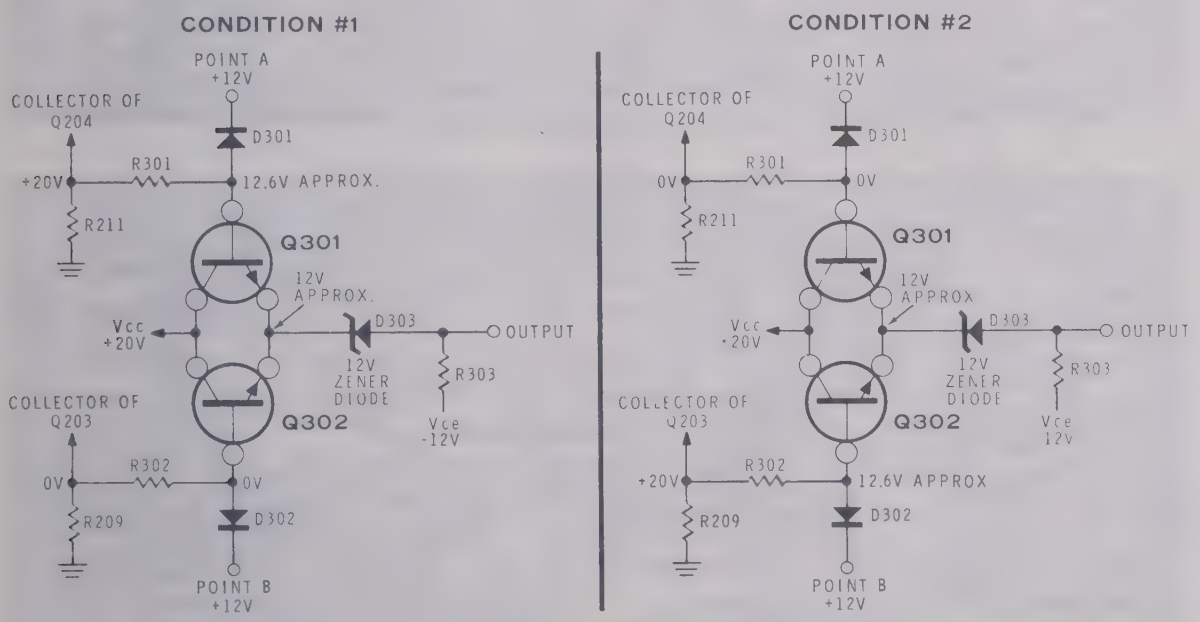
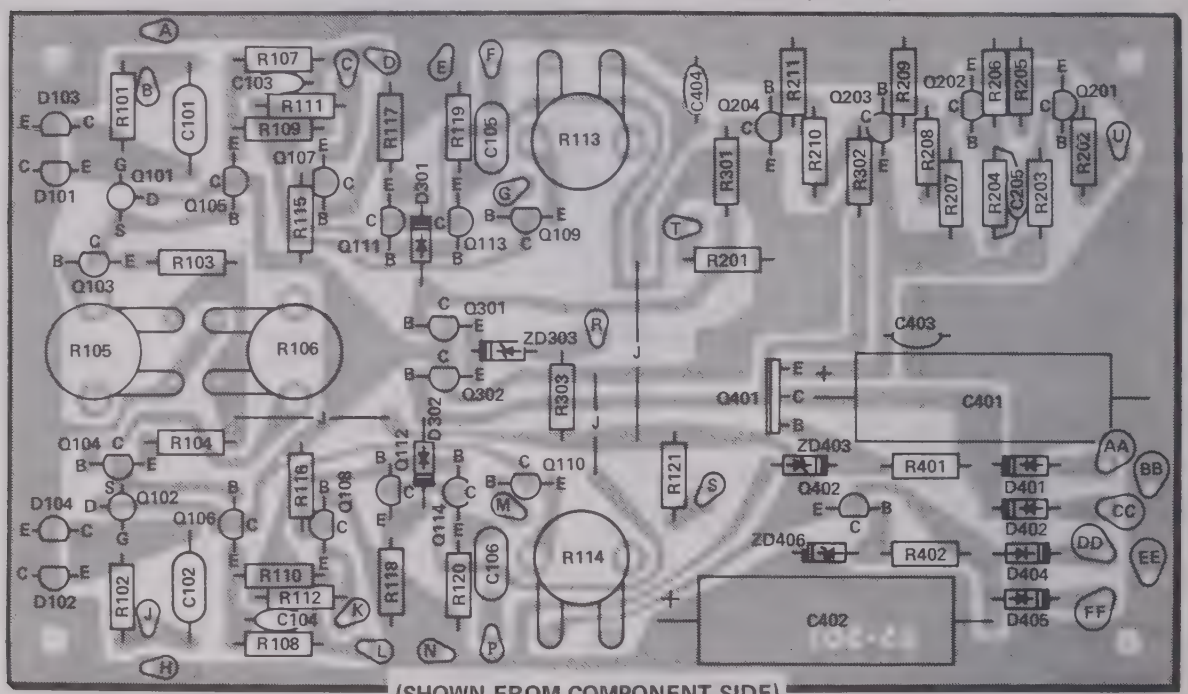


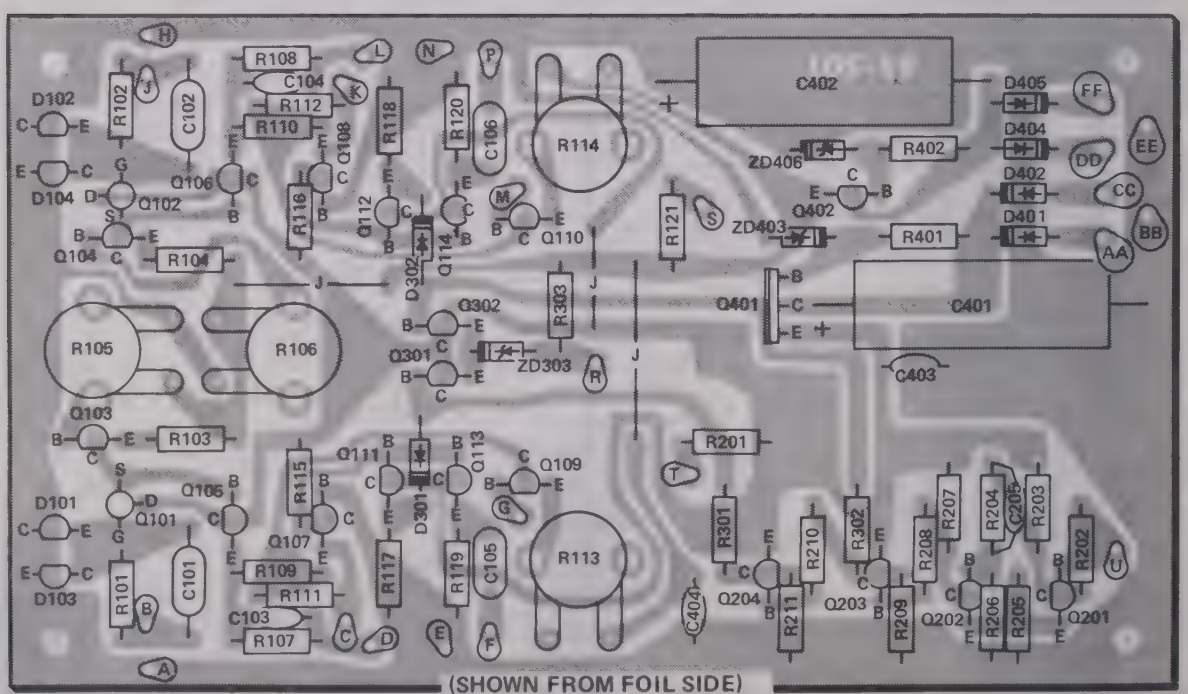
Figure 7

CIRCUIT BOARD X-RAY VIEWS

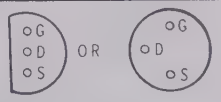
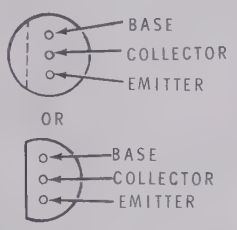
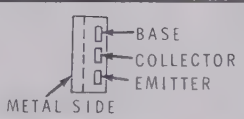
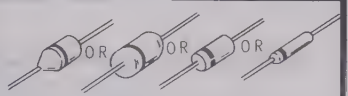
NOTE: To determine the value (22 kΩ, .05 μF, etc.) of one of these parts, you may proceed in either of the following ways.

1. Refer to the place where the part is installed in the Step-by-Step instructions.
2. Note the identification number of the part (R-number, C-number, etc.). Then locate the same identification number next to the part on the Schematic. The value, or "Description," of most parts will be near this number. For diodes and transistors, refer to the transistor-diode identification chart.



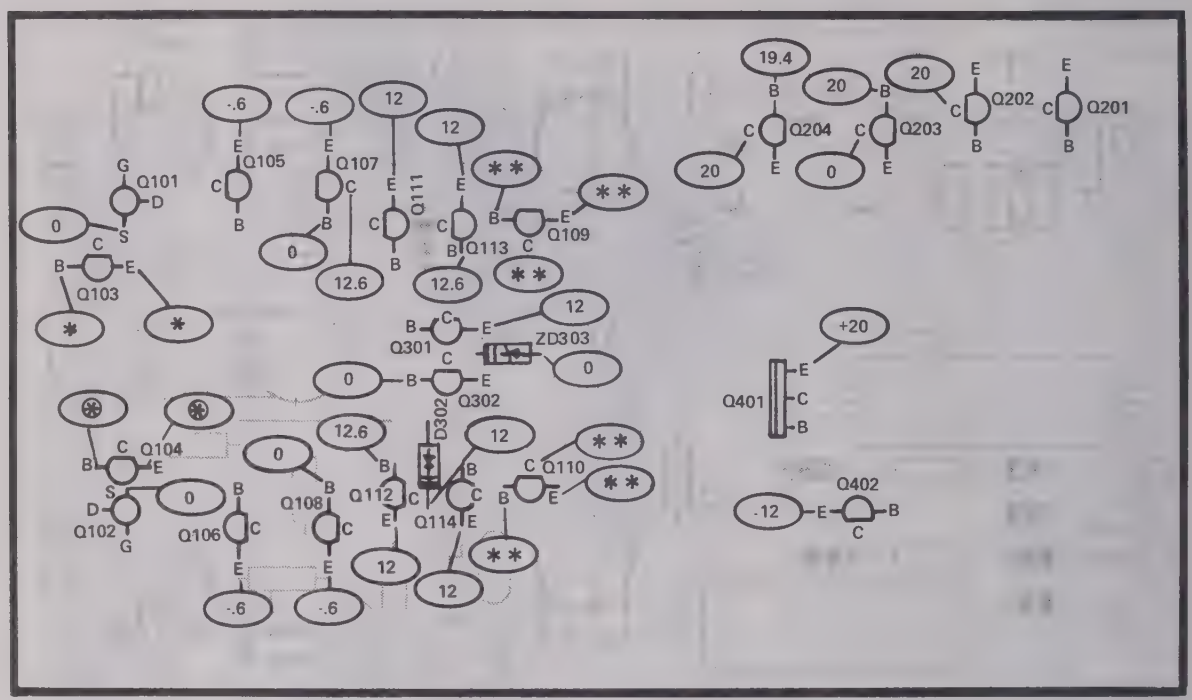


TRANSISTOR-DIODE IDENTIFICATION CHART

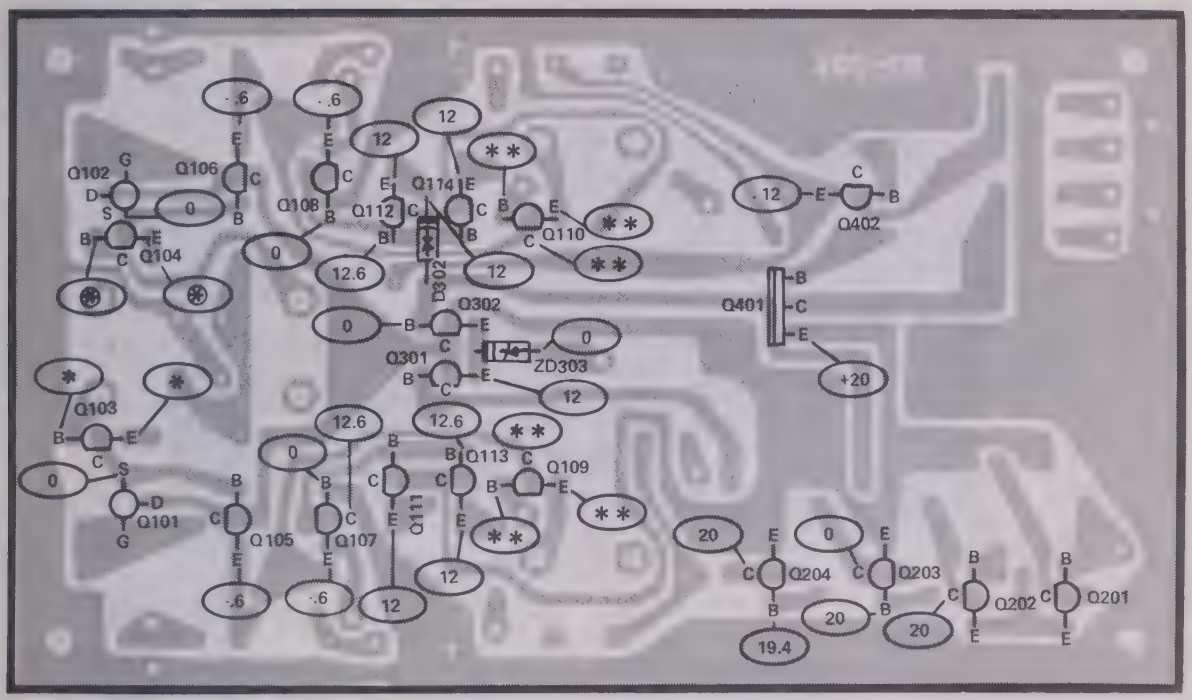
COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	BASE DIAGRAM (BOTTOM VIEW)
Q101, Q102	417-169	MPF105	
Q103-Q114 Q201, Q202 Q301, Q302 D101-D104	417-118	2N3393	
Q203, Q204 Q402	417-201	X29A829	
Q401	417-852	TIP31B	
D301, D302	56-56	G.E. OR T.I. 1N4149	 NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.
D401, D402 D404, D405	57-65	1N4002	
ZD403	56-45	VR-20	
ZD303, D406	56-57	1N716A	

VOLTAGE CHARTS

See the Schematic Notes for voltage conditions

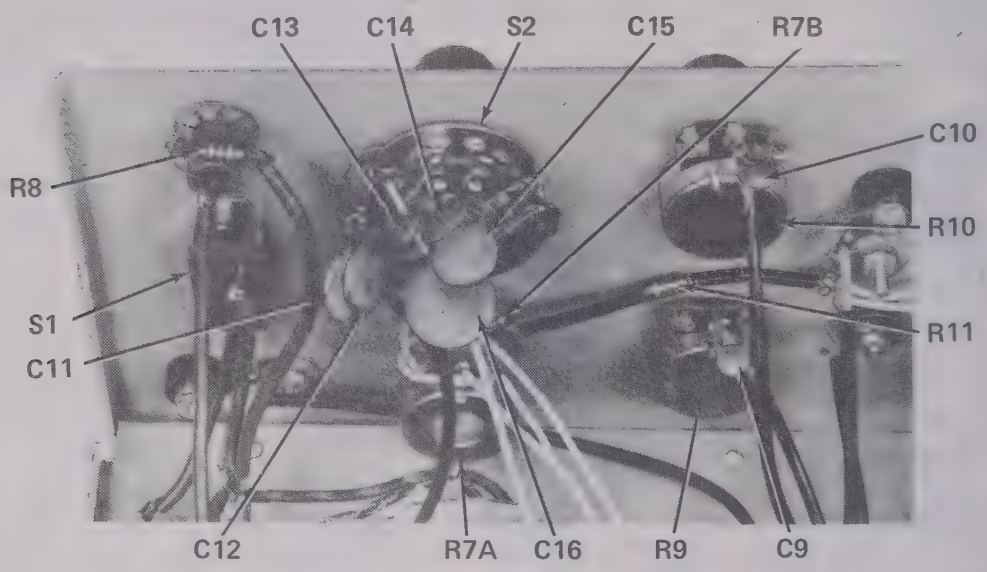


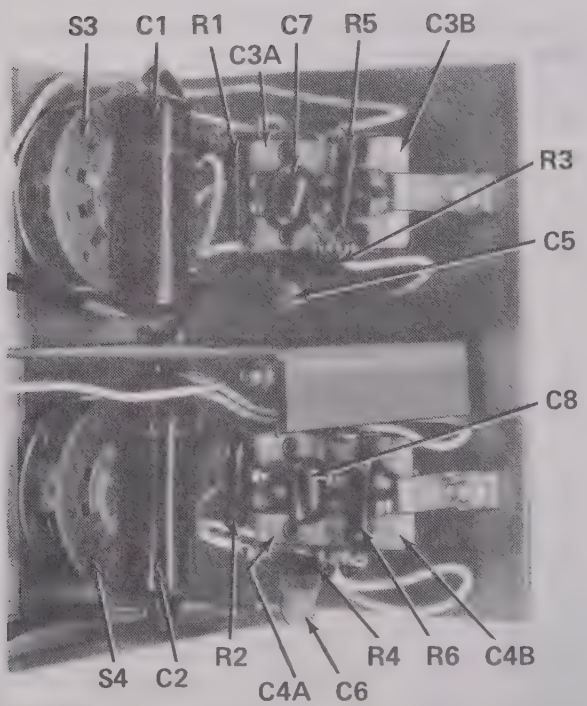
(SHOWN FROM COMPONENT SIDE)

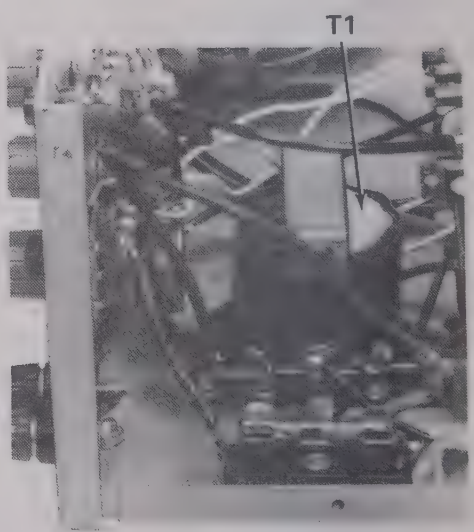


(SHOWN FROM FOIL SIDE)

CHASSIS PHOTOGRAPHS







SCHEMATIC OF THE HEATHKIT® ELECTRONIC SWITCH MODEL ID-101

NOTES:

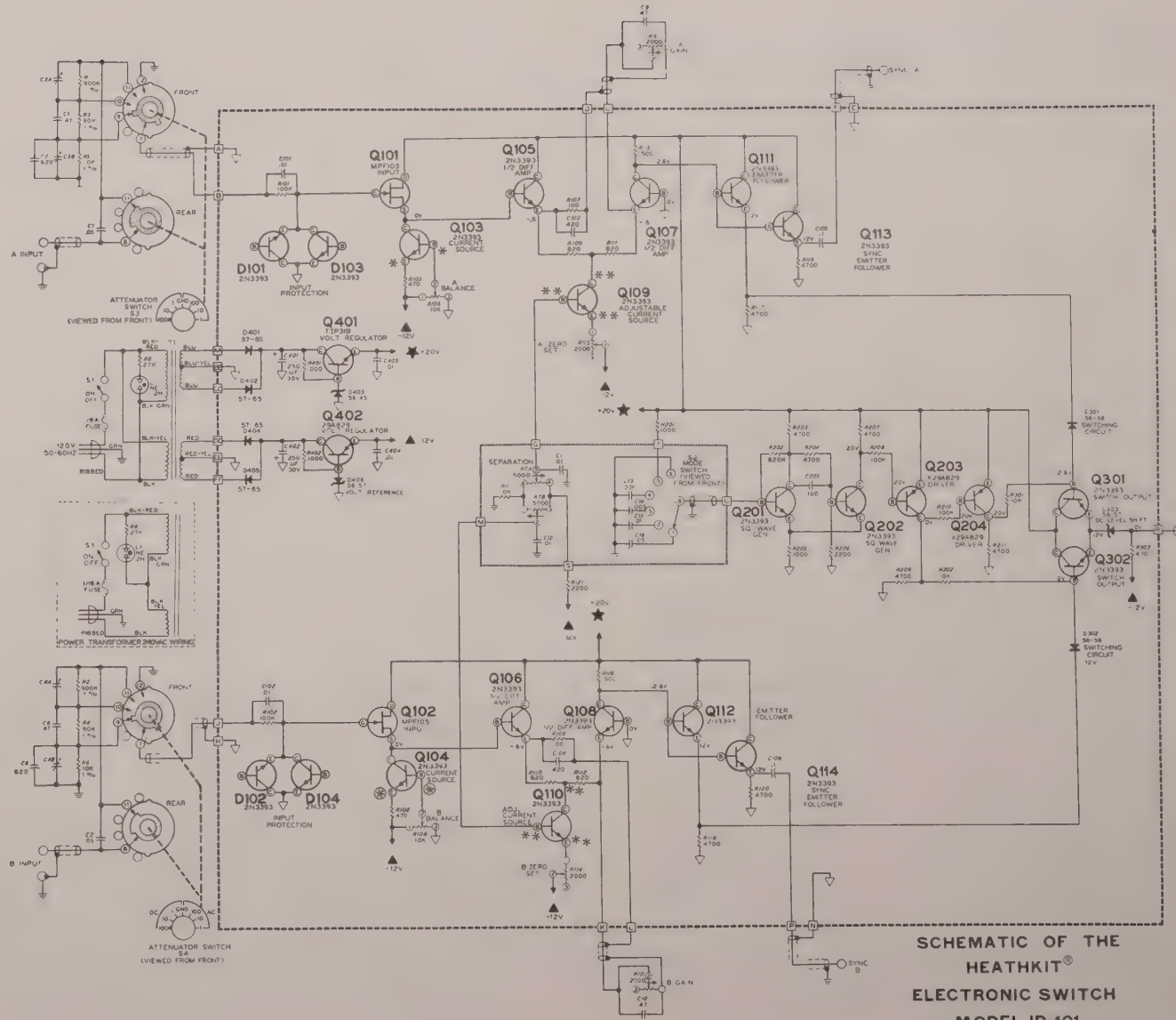
1. □ THIS SYMBOL INDICATES A SOLDERED WIRE CONNECTION ON THE CIRCUIT BOARD.
2. ▽ THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
3. ⏚ THIS SYMBOL INDICATES A CHASSIS GROUND
4. VOLTAGES TAKEN (AFTER PROPER ADJUSTMENTS HAVE BEEN MADE) WITH SWITCHES AND CONTROLS IN THE FOLLOWING POSITIONS

A AND B INPUT	-GND
A AND B GAIN	-MINIMUM
MODE	-A.
SEPARATION	-0.

5. ALL VOLTAGES WERE MEASURED WITH AN 11 MEGOHM VTVM FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY ±20%
6. * THIS SYMBOL INDICATES A VOLTAGE THAT VARIES WITH THE SETTING OF CONTROL R105 (CHANNEL A BALANCE).
   ** THIS SYMBOL INDICATES A VOLTAGE THAT VARIES WITH THE SETTING OF CONTROL R7 (SEPARATION).
   ⊛ THIS SYMBOL INDICATES A VOLTAGE THAT VARIES WITH THE SETTING OF CONTROL R106 (CHANNEL B BALANCE).
7. ALL RESISTORS ARE 1/2 WATT, 10%, UNLESS OTHERWISE SPECIFIED.
8. ALL CAPACITOR VALUES LARGER THAN 1.0 ARE IN PF UNLESS OTHERWISE SPECIFIED CAPACITOR VALUES LESS THAN 1.0 ARE IN µF
9. ALL SWITCHES SHOWN IN THE FULLY COUNTERCLOCKWISE POSITION AS VIEWED FROM THE KNOB END.
10. ⟶ THIS SYMBOL INDICATES A CLOCKWISE ROTATION OF CONTROLS AS VIEWED FROM THE KNOB END OF THE SHAFT OR ACCESSIBLE SIDE.
11. IDENTIFICATION NUMBERS FOR CAPACITORS, TRANSISTORS, CONTROLS, AND SWITCHES ARE IN THE FOLLOWING GROUPS

1- 99	FRONT PANEL, (OFF CIRCUIT BOARD).
100-199	CIRCUIT BOARD (PREAMPLIFIER).
200-299	CIRCUIT BOARD (SQUARE WAVE GENERATOR).
300-399	CIRCUIT BOARD (SWITCHING/OUTPUT CIRCUIT).
400-499	CIRCUIT BOARD (POWER SUPPLY).

12. ┅┅ THIS BORDER SURROUNDS COMPONENTS THAT ARE NOT MOUNTED ON THE CIRCUIT BOARD
13. ↓ THIS SYMBOL INDICATES A POWER CONNECTION.
    ★ THIS SYMBOL INDICATES A +20 VOLT CONNECTION.
    ▲ THIS SYMBOL INDICATES A -12 VOLT CONNECTION.



SCHEMATIC OF THE HEATHKIT® ELECTRONIC SWITCH MODEL ID-101

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

  Total enclosed $_____
- If you prefer COD shipment, check the COD box and mail this form. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date Purchased _____ Location Purchased _____

LIST **HEATH** PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE
TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUT ALONG DOTTED LINE

FOR PARTS REQUESTS ONLY

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TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

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CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

Replacement parts are maintained specifically to repair Heath products. Parts sales for other reasons will be declined.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

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MA22910

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